PB83-106997

Environmental Impact Statement
Twin Oak Steam Electric Station
Robertson County, Texas (Draft)

(U.S.) Environmental Protection Agency
Dallas, TX

Sep 82

U.S. Department of Commerce
National Technical Information Service
NTIS

United States
Environmental Protection
Agency

Region 6
1201 Elm Street
Dallas TX 75270

EPA 906/9-82-010
September 1982

Water

PB83-106997

EPA

Environmental Impact Statement

Draft

Twin Oak Steam Electric Station Robertson County, Texas

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1201 ELM STREET
DALLAS, TEXAS 75270

September 2, 1982

TO ALL INTERESTED AGENCIES, OFFICIALS, PUBLIC GROUPS AND INDIVIDUALS:

The Environmental Protection Agency (EPA) has prepared this Draft Environmental Impact Statement (EIS) concerning issuance of a new source National Pollutant Discharge Elimination System (NPDES) permit for wastewater discharge from the Twin Oak Steam Electric Station in Robertson County, Texas. The document has been prepared in compliance with the National Environmental Policy Act of 1969 and implementing regulations.

EPA will hold a public hearing on the Draft EIS at 7:30 p.m. on November 9, 1982, in the Robertson County Courthouse, District Courtroom, Third Floor, Franklin, Texas.

Comments on the Draft EIS will be considered in the preparation of the Final EIS. If the required changes are minor, EPA's Final EIS will incorporate the Draft EIS by reference and include only: (1) a revised summary, (2) revisions necessary to the Draft EIS as a result of public comment, (3) EPA's response to comments made on the Draft EIS, and (4) EPA's preferred action. Therefore, the Draft EIS should be retained for possible use in conjunction with the Final EIS. The Final EIS will be sent only to those who request a copy or who make substantive comments on the Draft EIS.

Written comments or inquiries regarding this EIS should be addressed to Mr. Clinton B. Spotts, Regional EIS Coordinator, at the above address by the date stamped on the cover sheet following this letter.

Sincerely yours,

Frances E. Phillips

Dick Whittington, P.E.
Regional Administrator

DRAFT ENVIRONMENTAL IMPACT STATEMENT
TWIN OAK STEAM ELECTRIC STATION
IN ROBERTSON COUNTY, TEXAS

RESPONSIBLE AGENCY: US Environmental Protection Agency, Region 6

COOPERATING AGENCY: Texas Railroad Commission

ADMINISTRATIVE ACTION: Issuing a New Source National Pollutant Discharge Elimination System (NPDES) permit to Texas Utilities Generating Company (TUGCO) for discharge of wastewater from the Twin Oak Steam Electric Station (TOSES) into Duck Creek.

CONTACT FOR FURTHER INFORMATION:
Clinton B. Spotts, Regional EIS Coordinator
US Environmental Protection Agency
1201 Elm Street
Dallas, Texas 75270
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ABSTRACT: EPA is considering issuance of a NPDES permit to TUGCO for discharge of cooling water from two 750 MW power generating units into Duck Creek, a tributary of the Navasota River. Approximately 3,393 acres will be utilized for the power plant site, including 2,330 acres for a cooling reservoir (Twin Oak Reservoir) constructed on Duck Creek. Make-up water to fill or supplement the reservoir will be pumped via a 12-mile (109-acre) pipeline from Lake Limestone. Wastes such as bottom ash, fly ash, and other solids will be disposed in on-site landfills. Electricity will be conveyed from the TOSES by a transmission system containing 3,089 acres of rights-of-way (1,502 acres of new rights-of-way). Lignite to fuel the TOSES will be transported 8 miles by electrical powered unit trains from three deposits totaling approximately 33,000 acres. About 822 acres of rights-of-way will be utilized by the rail system. The TOSES will require approximately 280 million tons of lignite during the 35-year life of the project. Notable effects associated with construction and operation of the TOSES and transport systems include increased erosion of soils; changes in intensity and possibly direction of runoff; increased air emissions of particulates, SO_2, and NO_x; increased noise levels; decrease in lotic and forested habitats; increase in lentic habitat; permanent conversion of portions of all land types to industrial use; visual degradation; and positive economic effects such as increased employment and revenues. Adverse effects from mining and reclamation include many of the above as well as an overall leveling of topography; possible decreased acreages of prime farmland; minor reduction in hunting and recreational opportunity; lowering of groundwater levels locally; possible acid leaching; and potential disturbance and mitigation of historic or prehistoric sites. Most of the positive effects of the project stem from economic benefits such as lignite royalities, increased tax base, and new jobs.

COMMENTS ON DRAFT EIS DUE: 15 NOV 1982

Responsible Official

Frances E. Phillips
Dick Whittington, P.E.
Regional Administrator

CHAPTER 1.0

SUMMARY

1.0 SUMMARY

1.1 DESCRIPTION OF ADMINISTRATIVE ACTION

The United States Environmental Protection Agency (EPA) is considering issuance of a new source National Pollutant Discharge Elimination System (NPDES) permit to Texas Utilities Generating Company (TUGCO) for their proposed Twin Oak Steam Electric Station (TOSES) in Robertson County, Texas. The proposed receiving water, Duck Creek, is a tributary of the Navasota River. EPA has prepared a draft NPDES permit for the discharge of wastewater from the TOSES (see Appendix C).

The National Environmental Policy Act of 1969 (NEPA) requires that Federal agencies prepare detailed environmental impact statements (EIS's) on actions significantly affecting the quality of the human environment. Furthermore, Section 511(c)(1) of the Federal Water Pollution Control Act (FWPCA or P.L. 92-500) as amended by the Clean Water Act of 1977 (P.L. 95-217) mandates that requirements of NEPA apply to issuance of a permit under Section 402 of FWPCA for the discharge of any pollutant by a "new source" as defined in Section 306 of FWPCA. EPA has determined that issuance of a new source NPDES permit to TUGCO for the proposed TOSES represents a major Federal action significantly affecting the quality of the human environment. Based on this determination, a detailed environmental impact statement on the proposed action was prepared.

1.2 DESCRIPTION OF PROPOSED PROJECT

The TOSES will consist of two 750 MW lignite-fired, electric generating units located approximately 11 miles north of Franklin, Texas in northern Robertson County. The 3,393-acre Twin Oak site consists of a 2,330-acre cooling reservoir (Twin Oak Reservoir), a 250-acre plant island, a 25-acre lignite storage area, a 570-acre fly ash disposal site, a 200-acre bottom ash disposal site, and 18 acres for plant entrance roads. The first unit will be operating commercially in 1988 and the second in 1990.

In addition to the Twin Oak plant site, there are approximately 2,433 acres associated with new transportation systems. Make-up water for Twin Oak Reservoir will come from Lake Limestone via a 12-mile pipeline with 109 acres of right-of-way. In addition, some 1,502 acres of new rights-of-way will be utilized for the power transmission lines that will convey electricity from the project site. Approximately 822 acres of rights-of way will also be necessary for a rail spur to supply lignite from mine units near the TOSES.

Although overall construction of the TOSES is less than 10% complete, certain components of the project are either in final stages of construction or already completed. As of 1 June 1982, the Twin Oak dam and reservoir were 95% complete; the make-up water pipeline 90% complete; the rail spur and grading for the plant site 100% complete.

Fuel for both units at the TOSES will be supplied from three discrete lignite mines located approximately 8 miles north and south from the Twin Oak project site. The mines comprise about 33,000 acres and will be operated by TUGCO. About 750 acres will be mined annually in a continuous process of surface mining, backfilling, and reclaiming. With both units in commercial operation, an annual capacity of near 70% is expected, which means that the plant will use, and the mine will be expected to produce approximately 7.9 million tons of lignite per year. Since the mine has been designated as an "existing source" by EPA, it is not subject to review under NEPA. However, EPA does consider the mine to be an integral part of the TOSES project, and therefore has included some mining impact analysis in this EIS. More specific environmental information should be available from the Texas Railroad Commission (TRC), since a mining permit must be issued by the TRC to TUGCO before mining can commence. It should be noted that EPA has already issued a NPDES permit for the Twin Oak mine effective 10 May 1982.

The proposed TOSES will utilize a liquid waste management system that will discharge wastewater effluents from eight proposed outfalls. Waste effluents will be produced by the following systems:

- Condenser non-contact cooling water (1,470 mgd);
- Lignite and limestone storage area rainfall runoff (variable flow);
- Sanitary sewage and other wastewater from potable water usage (14,800 gpd);
- Fuel oil unloading and storage area rainfall runoff (variable flow);
- Low volume wastewater, including equipment washdown, equipment drains, turbine building drainage, dust control (variable flow);
- Bottom ash sluicing; equipment cleaning, demineralizer wastes, condensate polisher, FGD washdown, boiler area rainfall runoff (variable flow);
- Fly ash and FGD system wastewater, rainfall runoff from FGD and ESP pipe area (variable flow); and
- Railroad area rainfall runoff (variable flow).

Discharges from these systems shall comply with NPDES permit limitations established in accordance with new source performance standards (40 CFR 423.15).

Solid waste produced by the TOSES will consist of large quantities of ash and process sludges, plus small volumes of wastewater treatment sludges and household-type refuse. Bottom ash, fly ash, and flue gas desulfurization sludge will be disposed of in a large, on-site landfill. Wastewater sludges and household-type garbage will be disposed of in a small, separate landfill area. Leachate and runoff from the landfill operations will be collected, treated, and discharged from a treatment pond.

The lignite reserve to be mined extends from Lake Limestone on the Navasota River to just south and east of Bremond. The lignite will be surface mined, using an area mining system with electric draglines, and combination truck, train, and belt conveyors to transport lignite to the adjacent TOSES. Reclamation plans include temporary cover and permanent revegetation with improved pasture. The mining project has a 35-year design life, with approximately 280 million tons of lignite intended to be mined during that time.

Prinicipal operations in the proposed mining sequence include clearing the mining area of trees and brush; removing overburden using electric draglines; loading and transporting lignite to the TOSES via mine haul roads, conveyors, and train; placing randomly mixed overburden back in the mine pits; and leveling and revegetation. Clearing and mining will occur on about 750 acres per year. At any one time approximately 1,500 to 3,750 acres may be involved in the mining sequence from initial clearing through the final stages of reclamation.

1.3 ALTERNATIVES EVALUATED

Various alternatives to the proposed TOSES were assessed by the permit applicant. These alternatives included the no action alternative; alternative power sources and generating methods; alternative power plant sites; power plant design alternatives; and transmission line alternatives. Texas Utilities determined that implementation of the no action alternative would result in failure to meet projected electrical energy demands in its service area.

Alternative methods of acquiring power required to meet the demand were evaluated including purchasing power from other sources, reactivating retired power plants, upgrading older plants, and reducing load growth. Alternative fuels and energy sources evaluated included geothermal energy, solar, wind, municipal waste, natural gas, oil, nuclear power, and solid fossil fuels (e.g., coal and lignite).

Several alternative components regarding power plant design were evaluated. These components included the condenser cooling water system, boiler make-up water intake systems (including surface and groundwater systems), plant discharge systems, liquid waste management systems, solid waste management systems, and air quality control systems. Many options for each system were reviewed and a cost-effective and environmentally acceptable option was chosen for each system.

Transmission system options evaluated by TUGCO included various corridor locations and alternative routes within the corridors, and evaluations of above-ground versus underground facilities. Above-ground facilities were selected for implementation.

Alternatives available to EPA are: (1) issue a new source NPDES permit to TUGCO for the proposed TOSES; or (2) denial of the NPDES permit. Conditional requirements or provisions may be added to the permit based on anticipated project impacts. These same issue/deny alternatives are also available to other state and Federal permitting agencies for those few permits still to be granted.

1.4 ENVIRONMENTAL CONSEQUENCES OF THE NO ACTION ALTERNATIVE

Since the Twin Oak project is currently being built, certain environmental effects, including the conversion of approximately 1,000 acres of agricultural land to industrial use, minor loss of wildlife habitat, fugitive dust generation, and soil erosion, have already occurred as a result of plant site grading, railroad spur construction, pipeline construction, and reservoir construction. If construction of the TOSES project is not completed, additional land disturbance activities would not occur, nor would the effects associated with the power plant operation. Also, the company's capital investments of approximately $132,000,000 would be lost as would benefits to the local economy. Because much of the project area is underlain by lignite, it is expected that resource development would eventually occur -- resulting in effects similar to those associated with the proposed project.

1.5 CONCLUSIONS REGARDING ENVIRONMENTAL CONSEQUENCES RESULTING FROM CONSTRUCTION AND OPERATION OF THE PROPOSED PROJECT

Construction and operation of the proposed Twin Oak project (TOSES, reservoir, and associated facilities; transport systems; coal deposits) will have beneficial and adverse effects on the area's existing cultural, biological, physical, and socioeconomic resources. The most notable potential effects due to the major activities are summarized by resource in the narrative that follows.

Earth Resources. Continued project construction will result in both short-term and long-term disruptions and changes in earth resources. The topography of the project area will be more level as a result of project activities, especially clearing and grading for the power plant, reservoir, and mine.

Long-term displacement of shallow surface sediments has occurred, and will occur because of construction activities associated with the power plant and reservoir. The stratigraphy of the mining sites will be altered to the depth of the lignite. Erosion of soil in all cleared areas will occur, although generally only over a short time period. Additional erosion may occur if erosion control techniques (mulching, seeding, etc.) are not implemented soon after disturbance. In addition, some prime farmlands may potentially be affected by the proposed project. Reclamation will result in a somewhat different soil profile over much of the project area where construction and mining activities occur. The productivity of the newly developed soils will depend largely on the level of management employed after reclamation.

Groundwater. No significant adverse effects to groundwater are expected from construction or operation of the TOSES or associated transport systems. An increase in recharge to the shallow alluvial aquifer will occur around Twin Oak Reservoir. Localized levels and quantities of groundwater may be reduced during mining by dewatering prior to and during active mining. A change in recharge characteristics of the mined lands will occur due to changes in stratigraphy which in turn will result in increased permeability of redeposited overburden. The possibility for dissolved solids or acidic materials to leach into shallow groundwater systems will also be increased following mining.

Surface Water. Adverse effects to surface waters in the Twin Oak project site and project area are expected to be minor. Most of the potential long-term adverse effects are associated with the mine. Sedimentation ponds will decrease runoff into area streams, especially during periods of low rainfall. Although sedimentation ponds will contain sediment upstream, erosion during their construction and prior to their successful reclamation will result in increased turbidity and sedimentation downstream. During mining, some streams will be destroyed or altered through rerouting of water via diversions. These diversions may result in higher flows and levels of suspended materials (turbidity) in stream systems due to their channels being straighter and shorter.

Air Quality. A minor change in local air quality will result from increased levels of emissions primarily from operation of the two 750 MW units at the TOSES, fugitive dust associated with clearing for all earth-moving activities, and active mining. Increased emissions of particulates, SO_2, and NO_x, from the TOSES will be long-term, but are not expected to exceed the NAAQS and therefore will not adversely affect public health and welfare. Radioactive trace emissions are also expected to be below Federal standards. Minor electric and magnetic fields emitted from transmission facilities, along with corona are not expected to create significant adverse effects.

Noise. Even though numerous increased noise emittors will be associated with the TOSES and mine, noise is not expected to be a major concern because of the predominantly rural setting and sparse population in the vicinity of the proposed project. Noise levels that will increase will be highly localized and of short duration.

Biological Resources. Development of the Twin Oak project will result in clearing and temporary or permanent conversion of approximately 38,826 acres of predominantly pasture and forestland. Existing vegetation and associated communities will be destroyed or modified incrementally over much of the area. Long-term changes will be most noticeable to the more mature and diverse communities such as the riparian and upland forest. Approximately 5,826 acres are associated with the TOSES and transport systems. Of this, only about 1,200 acres will be permanently converted to industrial uses. Most of the remaining area, less an area (approximately 10,500 acres) fenced around Twin Oak Reservoir, will be flooded or reclaimed in grassland. Some select groups of wildlife and a diversity of aquatic species, including fish, will utilize this new habitat once it is established. During the 35-year life of the mine, some 33,000 acres will be cleared. Clearing will result in a short-term decrease in acreage of all habitats. An overall long-term decrease in forested and riparian habitat and associated wildlife species will occur, as will an increase in grassland habitats and associated wildlife species.

Populations of Federally listed endangered or threatened species are not expected to be directly affected by the construction and operation of the Twin Oak project.

Cultural Resources. All Federal regulations and procedures relative to the protection of cultural resources have been satisfied for the TOSES, associated facilities, and rights-of-way along all transport systems. EPA, in coordination with the Texas State Historic Preservation Officer, has determined that the TOSES and auxiliary facilities will have no effect on cultural resources. However, cultural resource investigations for the mining sites are incomplete. The TRC, in consultation with the Texas SHPO, are responsible for protecting cultural resources associated with mining areas.

Socioeconomics. The proposed project will stimulate the area economy by increasing job opportunities both directly and indirectly. Some people will receive direct economic benefits through lignite royalties. Increased incomes will result in higher revenues for local governments. In addition to providing a stronger economic base in the rural project area, the increase in area investments, etc., will also stimulate the economy. Since most of the people are expected to relocate in larger outlying towns such as Waco, Bryan, and College Station, the effects on communities nearest the TOSES and Twin Oak mine will not be as significant as might be expected. Virtually all of these beneficial effects will be long-term.

Several additional minor effects are also expected. Life styles and attitudes may change slightly, since the median age in the project area is expected to decrease. Housing in smaller communities in the project area is scarce, and therefore most relocation, at least in the first few years, is expected in larger outlying cities such as Waco, Bryan, and College Station where more housing is available. Local government expenditures are expected to increase, along with the demand for community services. After several years, local revenues should offset these expenditures. Enrollment in area schools will increase, but according to the relocation model, the larger school districts in Waco, Bryan, and College Station will absorb most of the increases. Should the labor force reside in nearby communities, housing, wastewater treatment, water supply, educational facilities, etc. may be inadequate.

Land Use. The primary short-term effects will be the incremental conversion of 38,826 acres of predominantly grassland and grassland-forestland (grazingland) to industrial use (power plant and mine development). The TOSES, associated facilities, and transport facilities will require 5,826 acres, with the remaining 33,000 acres associated with the mine.

Long-term land conversion will occur on the mine sites after reclamation. Approximately 33,000 acres of predominantly grassland and grassland-forestland will be converted predominantly to pastureland. Of the 5,826 acres associated with the TOSES and transport systems, approximately 2,330 acres of predominantly grazingland will be converted to reservoir, while 1,063 acres will be converted to industrial uses. Part of the 822 acres needed for the rail spur will also be converted to industrial uses. Most of the 1,502 acres associated with the transmission rights-of-way and 109 acres associated with the pipeline rights-of-way can be returned to grazingland following construction.

Recreation and Aesthetics. Effects on recreation are generally expected to be minor. Forested recreation will be reduced over the long-term at both the power plant site and in mining areas. No recreation will be permitted in the 3,393 acres associated with the TOSES and Twin Oak Reservoir as well as in an additional 8,600 acres fenced around the plant site. Access will be restricted to certain areas before, during, and after mining, thus the recreational benefits from these areas will be lessened. Following successful reclamation, some hunting and other grassland recreation should be possible on most mined areas. Most aspects of the proposed project are expected to have adverse visual effects on the area landscape.

Transportation. Increased traffic volumes and the possibility of road capacities being exceeded are the primary problems relating to transportation. The most significant effects will occur during the construction stage of the power plant. Upgrading of some area roads will occur as a result of the proposed development.

Energy. Adequate supplies of fuels necessary to construct, operate, and maintain the proposed development presently exist in or near the project area. Lignite deposits in the area will be irretrievably committed to generation of electrical energy. Electrical energy generated by the TOSES will be provided to meet consumer demand in the system service area in 1988.

CHAPTER 2.0

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

1.0 SUMMARY 1-1

1.1 SUMMARY DESCRIPTION OF ADMINISTRATIVE ACTION 1-1

1.2 SUMMARY DESCRIPTION OF PROPOSED PROJECT 1-1

1.3 ALTERNATIVES EVALUATED 1-4

1.4 ENVIRONMENTAL CONSEQUENCES FROM THE NO ACTION ALTERNATIVE 1-5

1.5 CONCLUSIONS REGARDING ENVIRONMENTAL CONSEQUENCES RESULTING FROM CONSTRUCTION AND OPERATION OF THE PROPOSED PROJECTS 1-5

- Earth Resources 1-5
- Groundwater 1-6
- Surface Water 1-6
- Air Quality 1-7
- Noise 1-7
- Biological Resources 1-7
- Cultural Resources 1-8
- Socioeconomics 1-8
- Land Use 1-8
- Recreation and Aesthetics 1-9
- Transportation 1-9
- Energy Resources 1-9

2.0 TABLE OF CONTENTS 2-1

LIST OF TABLES 2-8

LIST OF FIGURES 2-12

3.0 INTRODUCTION 3-1

3.1 EPA'S LEGISLATIVE RESPONSIBLITY AND AUTHORITY 3-1

3.2 APPLICANT'S PROPOSED PROJECT 3-2

3.3 OTHER FEDERAL AND STATE LEGISLATIVE REQUIREMENTS 3-5

4.0 PURPOSE AND NEED 4-1

4.1 NEED FOR THE PROPOSED PROJECT 4-1

Page

4.1.1 National Energy Policy 4-1
4.1.2 Projected Electrical Demand 4-2
4.1.3 Projected Generating Capability 4-2
4.1.4 Fuel Requirement (Need for Mine) 4-6

4.2 PURPOSE OF THE EIS 4-6

5.0 DESCRIPTION OF ALTERNATIVES 5-1

5.1 NO-ACTION ALTERNATIVE 5-1

5.2 PROJECT ALTERNATIVES 5-2

5.2.1 Power Sources and/or Management Techniques 5-3
5.2.2 Fuel Sources 5-3
5.2.3 Power Plant Sites 5-3

5.2.3.1 Selection of Preliminary Sites 5-3
5.2.3.2 Evaluation of Preliminary Sites and Alternative Cooling Systems 5-10
5.2.3.3 Evaluation of Optimum Alternatives 5-10

5.2.4 Transmission Facilities 5-12

5.3 DESCRIPTION OF THE PROPOSED PROJECT 5-14

5.3.1 Proposed TOSES and Cooling Reservoir 5-19

5.3.1.1 TOSES Power Generation 5-19
5.3.1.2 TOSES Air Pollution Control System 5-22
5.3.1.3 TOSES Circulating Water System 5-24
5.3.1.4 TOSES Miscellaneous Water Systems 5-27
5.3.1.5 TOSES Water Pollution Control Systems 5-28
5.3.1.6 TOSES Solid Waste Disposal System 5-32
5.3.1.7 Hazardous Waste Management System 5-34
5.3.1.8 Cooling Reservoir 5-34
5.3.1.9 TOSES Schedules and Personnel Requirements 5-38

5.3.2 Transport Systems 5-39

5.3.2.1 Transmission Lines 5-39
5.3.2.2 Make-up Water Pump Station and Pipeline 5-46
5.3.2.3 Railroad Spur 5-46

5.3.3 Mine 5-48

5.3.3.1 Lignite Analysis 5-48
5.3.3.2 Transportation and Storage 5-48
5.3.3.3 Mine Plan 5-48
5.3.3.4 Mine Schedule 5-51
5.3.3.5 Mining Method 5-51

Page

5.3.3.6 Environmental Control 5-51
5.3.3.7 Permit Aquisition 5-57

5.4 ALTERNATIVES AVAILABLE TO EPA 5-58

5.5 ALTERNATIVES AVAILABLE TO OTHER PERMITTING AGENCIES 5-58

6.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED PROJECTS 6-1

6.1 EARTH RESOURCES 6-1

6.1.1 Existing Conditions 6-1

6.1.1.1 Topography 6-1
6.1.1.2 Geology 6-2
6.1.1.3 Minerals 6-4
6.1.1.4 Soils 6-4

6.1.2 Environmental Consequences from the No Action Alternative .. 6-10
6.1.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-10

6.1.3.1 TOSES and Associated Facilities 6-10
6.1.3.2 Transport Systems 6-14
6.1.3.3 Mine 6-15

6.2 GROUNDWATER 6-17

6.2.1 Existing Conditions 6-17

6.2.1.1 Hydrology 6-17
6.2.1.2 Quantity 6-18
6.2.1.3 Quality 6-22
6.2.1.4 Usage 6-26

6.2.2 Environmental Consequences from the No Action Alternative .. 6-29
6.2.3 Environmental Consequences from the Construction and Operation of the Proposed Projects 6-29

6.2.3.1 TOSES and Associated Facilities 6-29
6.2.3.2 Transport Systems 6-29
6.2.3.3 Mine 6-29

6.3 SURFACE WATER 6-31

6.3.1 Existing Conditions 6-31

6.3.1.1 Hydrology 6-31
6.3.1.2 Water Quality 6-32
6.3.1.3 Water Supplies, Water Uses, and Water Rights 6-42

Page

6.3.2 Environmental Consequences from the No Action Alternative .. 6-46
6.3.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-47

6.3.3.1 TOSES and Associated Facilities 6-47
6.3.3.2 Transport Systems 6-48
6.3.3.3 Mine 6-49

6.4 AIR QUALITY 6-52

6.4.1 Existing Conditions 6-52

6.4.1.1 Climate/Meteorology 6-53
6.4.1.2 Applicable Regulations 6-57
6.4.1.3 Ambient Air Quality 6-61

6.4.2 Environmental Consequences from the No Action Alternative .. 6-64
6.4.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-64

6.4.3.1 TOSES and Associated Facilities 6-64
6.4.3.2 Transport Systems 6-71
6.4.3.3 Mine 6-72

6.5 SOUND QUALITY 6-73

6.5.1 Existing Conditions 6-73

6.5.1.1 Applicable Regulations 6-76

6.5.2 Environmental Consequences from the No Action Alternative .. 6-76
6.5.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-78

6.5.3.1 TOSES and Associated Facilities 6-78
6.5.3.2 Transport Systems 6-79
6.5.3.3 Mine 6-80

6.6 BIOLOGICAL RESOURCES 6-82

6.6.1 Existing Conditions 6-82

6.6.1.1 Aquatic Communities 6-82
6.6.1.2 Terrestrial Communities 6-86
6.6.1.3 Endangered or Threatened Species 6-93

6.6.2 Environmental Consequences from the No Action Alternative .. 6-95
6.6.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-95

6.6.3.1 TOSES and Associated Facilities 6-95

Page

6.6.3.2 Transport Systems 6-98
6.6.3.3 Mine 6-99

6.7 CULTURAL RESOURCES 6-108

6.7.1 Existing Conditions 6-108

6.7.1.1 Laws and Regulations 6-108
6.7.1.2 Cultural Resources of the Project Area 6-109
6.7.1.3 Results of Cultural Resource Investigations 6-110

6.7.2 Environmental Consequences from the No Action Alternative .. 6-112
6.7.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-112

6.7.3.1 TOSES and Associated Facilities 6-112
6.7.3.2 Transport Systems 6-112
6.7.3.3 Mine 6-114

6.8 SOCIOECONOMIC RESOURCES 6-114

6.8.1 Existing Conditions 6-114

6.8.1.1 Demographic Characteristics 6-114
6.8.1.2 Economic Activity and Trends 6-117
6.8.1.3 Housing 6-120
6.8.1.4 Community Facilities 6-122

6.8.2 Environmental Consequences from the No Action Alternative .. 6-124
6.8.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-128

6.8.3.1 Population 6-128
6.8.3.2 Employment 6-133
6.8.3.3 Income 6-136
6.8.3.4 Government Finances 6-136
6.8.3.5 Community Services and Facilities 6-138

6.9 LAND USE 6-140

6.9.1 Existing Conditions 6-140

6.9.1.1 Project Area 6-140
6.9.1.2 Project Site 6-140
6.9.1.3 Transport Systems 6-143
6.9.1.4 Mine Site 6-143
6.9.1.5 Land Use Controls and Building Regulations 6-143

6.9.2 Environmental Consequences from the No Action Alternative .. 6-143
6.9.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-145

Page

6.9.3.1 TOSES and Associated Facilities 6-145
6.9.3.2 Transport Systems 6-145
6.9.3.3 Mine 6-146

6.10 RECREATION AND AESTHETICS 6-147

6.10.1 Existing Conditions 6-147
6.10.2 Environmental Consequences from the No Action Alternative 6-147
6.10.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-147

6.10.3.1 TOSES and Associated Facilities 6-148
6.10.3.2 Transport Systems 6-148
6.10.3.3 Mine 6-148

6.11 TRANSPORTATION 6-149

6.11.1 Existing Conditions 6-149

6.11.1.1 Highways 6-149
6.11.1.2 Railroads 6-149
6.11.1.3 Airports and Air Service 6-149

6.11.2 Environmental Consequences from the No Action Alternative 6-153
6.11.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-153

6.11.3.1 TOSES and Associated Facilities 6-153
6.11.3.2 Transport Systems 6-156
6.11.3.3 Mine 6-157

6.12 PUBLIC HEALTH 6-160

6.12.1 Existing Conditions 6-160

6.12.1.1 Extraction 6-160
6.12.1.2 Transportation 6-161
6.12.1.3 Combustion 6-161
6.12.1.4 Waste Disposal 6-161

6.12.2 Environmental Consequences from the No Action Alternative 6-161
6.12.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-162

6.12.3.1 TOSES and Associated Facilities 6-162
6.12.3.2 Transport Systems 6-163
6.12.3.3 Mine 6-163

Page

6.13 ENERGY RESOURCES 6-164

6.13.1 Existing Conditions 6-164
6.13.2 Environmental Consequences from the No Action Alternative 6-165
6.13.3 Environmental Consequences from Construction and Operation of the Proposed Projects 6-165

6.13.3.1 TOSES and Associated Facilities 6-165
6.13.3.2 Transport Systems 6-165
6.13.3.3 Mine 6-166

6.14 EFFECTS OF ALTERNATIVES AVAILABLE TO EPA 6-166

6.14.1 Issuance of Permit 6-167
6.14.2 Denial of Permit 6-167

6.15 EFFECTS OF ALTERNATIVES AVAILABLE TO OTHER PERMITTING AGENCIES 6-167

6.16 IRRETRIEVABLE AND IRREVERSIBLE RESOURCE COMMITMENTS 6-168

6.17 UNAVOIDABLE ADVERSE IMPACTS 6-169

6.18 EFFECTS OF CUMULATIVE DEVELOPMENT 6-170

7.0 COORDINATION 7-1

7.1 RESPONSIVENESS SUMMARY FOR THE SCOPING MEETING 7-1

7.2 COOPERATING AGENCIES 7-2

7.3 SIGNIFICANT CORRRESPONDENCE 7-2

7.4 MAILING LIST FOR DRAFT EIS 7-2

8.0 LIST OF PREPARERS 8-1

9.0 BIBLIOGRAPHY 9-1

10.0 GLOSSARY 10-1

11.0 APPENDICES

APPENDIX A SIGNIFICANT CORRESPONDENCE A-1

APPENDIX B AIR QUALITY B-1

APPENDIX C NPDES PERMIT C-1

INDEX 1

LIST OF TABLES

Table		Page
3-1	Federal and state permits and certifications for which applications have been submitted	3-6
4-1	Projected demand for electrical power in the TP&L service area versus TP&L generating capacity with and without the TOSES during the years 1985 through 1990	4-3
4-2	Projected demand for electrical power in the TUCS service area versus the company's generating capability with and without TOSES during the years 1985 through 1990	4-4
5-1	Summary evaluation of alternatives for satisfying electric power demand	5-4
5-2	Summary evaluation of alternative fuel sources for the proposed 1,500 to 3,000 MW SES	5-6
5-3	Criteria for the selection and evaluation of alternative SES sites	5-8
5-4	Optimal power plant and reservoir site alternatives selected for detailed evaluation	5-11
5-5	Detailed evaluation of optimal site alternatives for a 1,500 to 3,000 MW SES	5-13
5-6	Evaluation of alternative transmission line routes	5-16
5-7	Maximum controlled emissions anticipated with both units operating	5-25
5-8	Wastewaters to be collected, treated, and discharged via eight outfalls	5-29
5-9	Pertinent design and engineering data for the proposed Twin Oak Dam and Reservoir	5-36
5-10	Personnel requirements for construction and operation	5-40
5-11	Transmission facilities proposed for utilization in conjunction with the proposed TOSES	5-42
5-12	Lignite analysis for Twin Oak mines	5-49
5-13	Major milestones for the first five-year deposit	5-52
5-14	Major equipment and facilities schedule	5-56

LIST OF TABLES (continued)

Table		Page
6-1	Ash and sulfur content of Twin Oak lignite	6-5
6-2	Trace element content in Twin Oak lignite	6-6
6-3	Properties of general soil associations	6-9
6-4	Soils chemistry data	6-12
6-5	Summary of groundwater analyses from wells	6-24
6-6	Use of groundwater in Limestone and Robertson Counties	6-27
6-7	Public use of groundwater from the Wilcox Aquifer	6-28
6-8	Data from streamflow gauging stations	6-35
6-9	Duration of daily flow (ft.^{3}/sec.) from gauging stations	6-42
6-10	Seven day low-flow data for various recurrence intervals	6-43
6-11	Surface water quality data for Duck Creek	6-40
6-12	TDWR water quality standards segment 1209 Brazos River	6-41
6-13	Water quality of four stations in project area	6-43
6-14	Recorded pH ranges for rainfall for four towns in Texas	6-54
6-15	Interpolated mean mixing layer heights	6-58
6-16	Percent time atmospheric temperature inversion occurs	6-58
6-17	National ambient air quality standards	6-59
6-18	Maximum allowable PSD increment by class	6-60
6-19	Background air quality concentrations for TSP and SO_2	6-62
6-20	Ambient air concentrations at Waco, Texas	6-62
6-21	Air quality monitoring at the TOSES site in 1974	6-63
6-22	Emission inventory for point and area sources	6-65
6-23	Point sources with TACB permits within a 50 mile radius of the TOSES	6-66
6-24	PSD and TACB emission limits	6-67

LIST OF TABLES (continued)

Table Page

6-25 Maximum predicted concentrations of SO_2 and particulates ... 6-68

6-26 TSP emission factors for surface coal mines 6-73

6-27 Summary of noise level data in the project area 6-77

6-28 Yearly L_{dn} values to protect public health and welfare 6-77

6-29 Anticipated sound level at 50 feet from mining activity 6-81

6-30 Summarizaiton of aquatic biota data 6-83

6-31 Representative plant and animal species 6-87

6-32 Cultural sites recommended for testing 6-113

6-33 Population projections for counties in the project area 6-118

6-34 Total unemployed and unemployment rates in the project area 6-119

6-35 Local government finances in the project area 6-121

6-36 Projected cumulative housing units needed in the project area without the TOSES project 6-123

6-37 Availability of hospital beds in the project area 6-125

6-38 Paid police, firemen, and teachers in the project area 6-126

6-39 Sanitary landfill solid waste permit status in the project area 6-127

6-40 Projected construction and operation workers for the Twin Oak projects 6-129

6-41 Estimated distribution of population influx 6-134

6-42 Distribution of demand for additional housing units 6-139

6-43 Acreages of major land use/land cover types in the project area 6-142

6-44 Land use controls and building regulations 6-144

6-45 Highway and railway mileage for counties in the project area 6-150

LIST OF TABLES (concluded)

Table | | Page
6-46 Airports in the project area 6-152

6-47 Estimated traffic volumes generated by power plant workers 6-155

6-48 Estimated traffic volumes generated by the mine workers 6-158

6-49 Anticipated employment for various lignite projects in the vicinity of the proposed TOSES 6-171

LIST OF FIGURES

Figure		Page
3-1	Geographical location of the project area and project site	3-3
3-2	TOSES project area and general project layout	3-4
5-1	Eleven alternative power plant sites selected by the permit applicant for initial evaluation	5-9
5-2	Location of proposed transmission lines and alternate routes associated with the proposed TOSES	5-15
5-3	Location of proposed TOSES, support facilities, and lignite mine	5-17
5-4	Schematic of proposed TOSES plant island	5-20
5-5	Proposed TOSES circulating water system	5-26
5-6	Location of proposed TOSES wastewater discharge outfalls	5-30
5-7	138KV single circuit wood H-frame proposed for use on TOSES transmission line(s)	5-43
5-8	138KV double circuit steel tower proposed for use on TOSES transmission line(s)	5-44
5-9	345KV double circuit steel tower proposed for use on TOSES transmission line(s)	5-45
5-10	345KV double circuit steel tower proposed for use on TOSES transmission line(s)	5-47
5-11	Conceptual schematic illustrating proposed surface mining process	5-55
6-1	Topography of the Twin Oak project site	6-3
6-2	Major soil units in the TOSES	6-8
6-3	Location of soil sampling sites	6-11
6-4	Cross-section of major aquifers	6-19
6-5	Sedimentary outcrops containing groundwater	6-20
6-6	Project area in relation to Brazos River Basin	6-21
6-7	Location of twelve sampling sites for groundwater	6-23

LIST OF FIGURES (Concluded)

Figure		Page
6-8	Flood hazard areas	6-33
6-9	USGS surface water monitoring stations	6-34
6-10	Location of surface water sampling sites on Duck Creek	6-39
6-11	Annual wind rose for Waco, Texas (1969-1973)	6-56
6-12	Location of twelve sampling sites for noise	6-88
6-13	Location of aquatic sampling sites	6-84
6-14	Terrestrial sampling locations	6-89
6-15	Major vegetation cover on the project site	6-90
6-16	Incorporated and unicorporated towns in the project area	6-115
6-17	Estimated population influx during peak construction year	6-130
6-18	Estimated population influx during operation	6-132
6-19	Major land use/land cover in the project area	6-141
6-20	Average annual 24-hour traffic volume for the project area	6-151
6-21	Location of major lignite energy projects in the region	6-172

CHAPTER 3.0

INTRODUCTION

3.0 INTRODUCTION

3.1 EPA'S LEGISLATIVE RESPONSIBILITY AND AUTHORITY

The US Environmental Protection Agency (EPA), under the Clean Water Act is required to establish standards of performance for categories of new source industrial wastewater discharges. Prior to discharge of a pollutant to navigable waters of the United States by a new source (as defined in Section 306) in an industrial category where performance standards are proposed, a new source National Pollutant Discharge Elimination System (NPDES) permit must be obtained from either EPA or the state (whichever is the administering authority in the state where the discharge is proposed). Section 511(c)(1) of the Clean Water Act also requires the issuance of a permit under Section 402 by EPA for a new source discharge be subject to the National Environmental Policy Act (NEPA), which may require preparation of an Environmental Impact Statement (EIS) on the new source. EIS preparation is required on any new source project significantly affecting the quality of the human environment. The procedure established by EPA regulations (40 CFR 6 Subpart F) for applying NEPA to the issuance of new source NPDES permits usually requires the permit applicant to prepare an Environmental Information Document (EID). In this situation, an EID was prepared by Texas Utilities Services, Inc. (TUSI - a subsidiary of Texas Utilities Company System - TUCS), for the Twin Oak Steam Electric Station (TOSES). Based on review of the EID and other criteria contained in Section 6.605 (40 CFR 6 Subpart F), EPA decided to prepare this Environmental Impact Statement (EIS) concerning issuance of a new source NPDES permit for the TOSES. A Notice of Intent for EIS preparation was distributed by EPA on 2 July 1981. Since construction has commenced on this project, TUSI has entered into an agreement with EPA as a result of Administrative Order VI-81-401. In this agreement, TUSI has agreed to implement any EIS related mitigation contained in a final NPDES permit pursuant to 40 CFR 122.66 (c)(4)(i).

EPA has designated the associated Twin Oak mine as an existing source and will therefore not prepare a EIS for the mine. However, the mine is considered an integral part of the TOSES project and is addressed in this EIS accordingly.

3.2 APPLICANT'S PROPOSED PROJECT

Development of the TOSES came in response to the national objective to reduce dependence on oil and natural gas for boiler fuels by increasing the use of resources such as lignite, coal, and nuclear fuels. This factor, coupled with projected annual increases in demand within the Texas Utilities System service area, required that new generating facilities be constructed.

Texas Power and Light Company (TP&L) and the Aluminum Company of America (ALCOA) have initiated construction and propose operation of a lignite-fired mine-mouth steam electric generating station (i.e., the TOSES) in Robertson County, Texas. The generating facility has been designed and will be constructed by TUSI. Texas Utilities Generating Company (TUGCO) will operate the station when completed. The TOSES will consist of two 750 megawatt (MW) steam electric generating units, lignite handling facilities, a rail spur, switchyard and transmission lines. In addition, a dam and cooling reservoir will be located on Duck Creek. A pipeline from Lake Limestone on the Navasota River will supply make-up water for the cooling reservoir. Of the approximately 1500 MW proposed to be generated at the TOSES, 75% will be distributed within the Texas Utilities Company System. The remaining 25% will be utilized by ALCOA.

The TOSES is located in southeast Texas (Figure 3-1). The project area, defined as a 30-mile radius around the Twin Oak project site, is the primary area of influence for the proposed plant and mine. The project site (Figure 3-2) is approximately 11 miles north of Franklin, Texas. It contains the TOSES, cooling reservoir, and ancillary facilities. A total of 3,393 acres will be required for the plant and reservoir, 822 acres for the railroad spur, 109 acres for the pipeline, and 1,502 acres for new power transmission line rightsof-way.

Twin Oak Reservoir was constructed in 1981 by placement of a compacted earth dam across Duck Creek. The reservoir will be operated at a normal pool elevation of 401 feet above mean sea level (msl). At this elevation, the surface area will be 2,330 acres with a storage of 30,300 acre-feet. Water will be withdrawn from Lake Limestone by a pump station on the western shore to provide make-up water for the Twin Oak Reservoir. A 12-mile long, 42-inch diameter

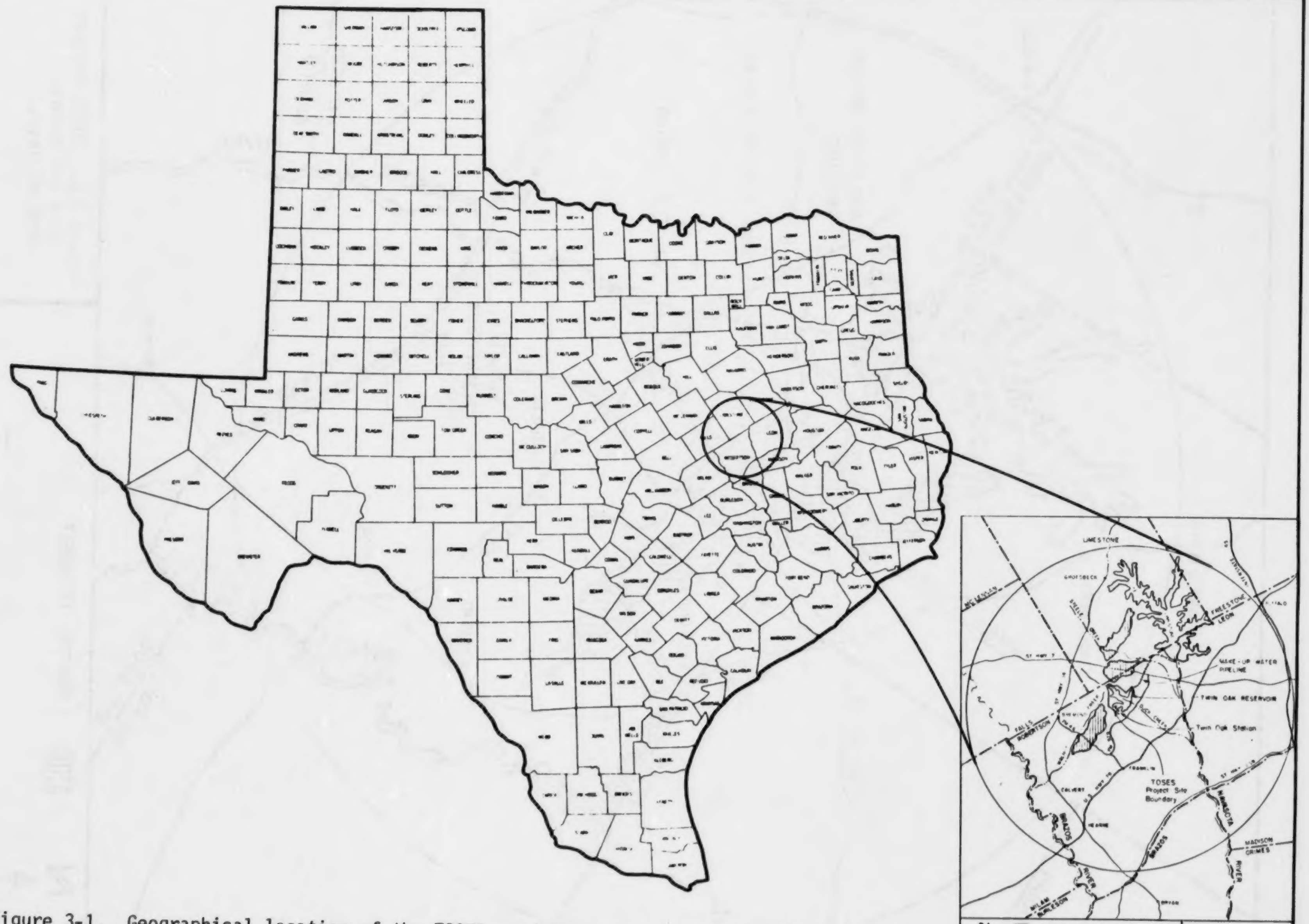
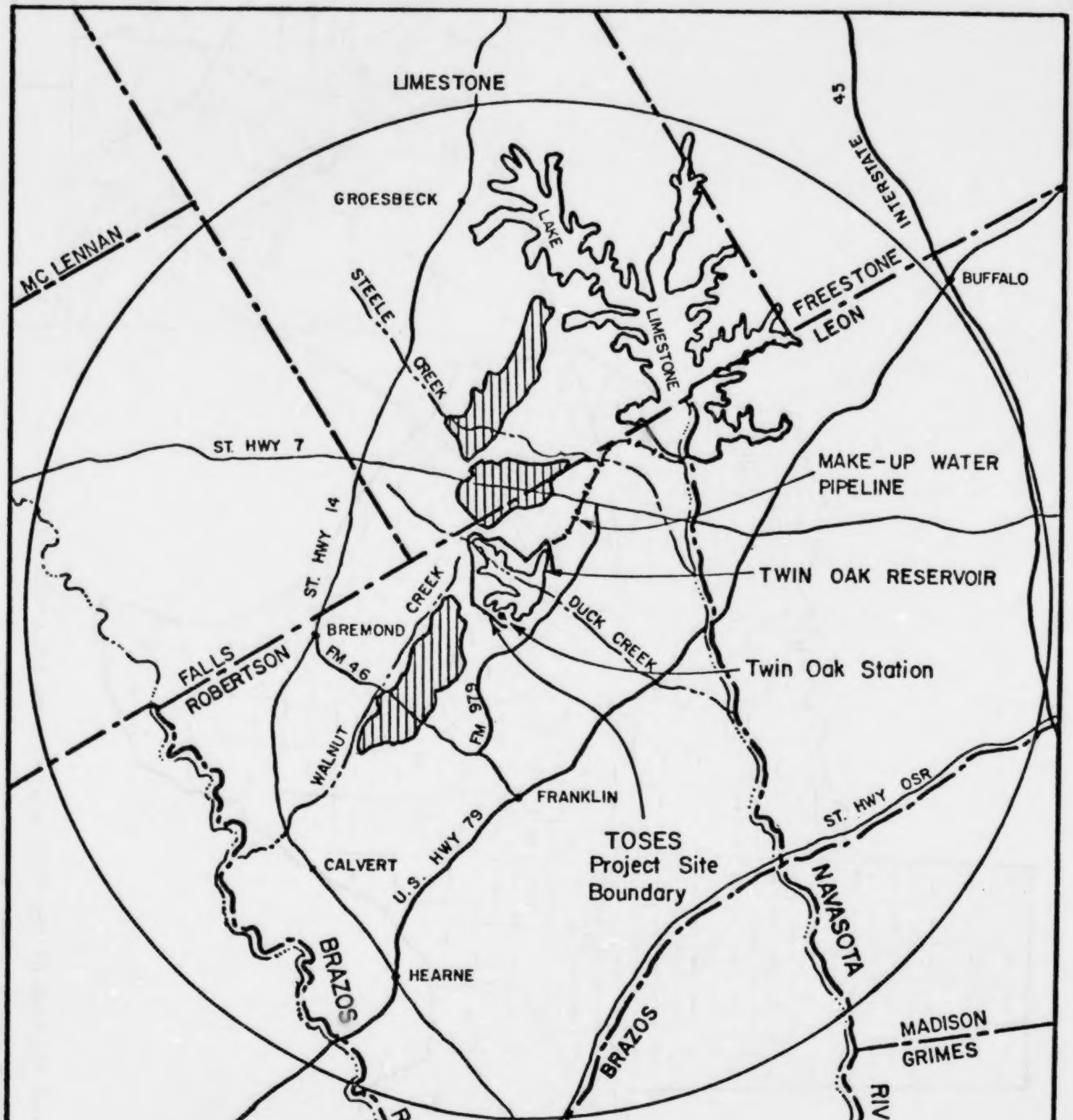

LIMESTONE
GROESBECK
McLENNAN
STEELE CREEK
FREESTONE
LEON
ST HWY 7
MAKE-UP WATER PIPELINE
TWIN OAK RESERVOIR
Twin Oak Station
FALLS
ROBERTSON
DUCK CREEK
FRANKLIN
CALVERT
U.S. HWY 79
TOSES Project Site Boundary
HEARNE
BRAZOS
RIVER
NAVASOTA
MADISON
GRIMES
MILAM
BURLESON
BRYAN
N
LIGNITE DEPOSIT

Figure 3-1. Geographical location of the TOSES project area and project site.


LIMESTONE
INTERSTATE 45
GROESBECK
LAKE
LIMESTONE
MC LENNAN
STEELE CREEK
FREESTONE
LEON
BUFFALO
ST. HWY 7
MAKE-UP WATER PIPELINE
ST. HWY 14
TWIN OAK RESERVOIR
CREEK
DUCK CREEK
BREMOND
FM 46
Twin Oak Station
FALLS
ROBERTSON
FM 979
WALNUT
FRANKLIN
ST. HWY OSR
TOSES Project Site Boundary
CALVERT
U.S. HWY 79
NAVASOTA
HEARNE
BRAZOS
BRAZOS
MADISON
GRIMES
RIVER
RIVER
MILAM
BURLESON
BRYAN

N ↑

▥ LIGNITE DEPOSIT

SCALE: 1" = 8 miles

Figure 3-2. TOSES project area and general project layout.

concrete pipeline will convey make-up water and discharge through an outlet structure into a small tributary branch of Twin Oak Reservoir.

The first 750 MW generating unit is scheduled for commercial operation in February 1988. The second unit is scheduled for commercial operation in February 1990. On-site construction of boiler foundations for both units began in the first quarter of 1979 in order to comply with TUSI's Texas Air Control Board (TACB) permit. Start of construction under Section 165 of the Clean Air Act was reported to EPA on 3 March 1978, in order to comply with the provisions of the Prevention of Significant Deterioration (PSD) permit. Presently, overall construction of the TOSES is less than 10% complete.

Fuel for both units at TOSES will come from the nearby Twin Oak surface lignite mine which is comprised of three distinct mining areas totaling approximately 33,000 acres. Mining areas are located about 8 miles northeast and southwest of the TOSES project site. Much of the detailed information for the mine has not yet been developed. With both Twin Oak units in operation at an annual capacity factor of 70%, the production of lignite from the mine will be approximately 7.9 million tons per year. Lignite will be transported by approximately 15 trucks over a series of short haul roads to loading stations at each deposit. Company-owned and operated electric unit trains will then transport the lignite to the plant daily.

3.3 OTHER FEDERAL AND STATE LEGISLATIVE REQUIREMENTS

Federal and state permits and approvals required for construction and operation of TOSES are listed in Table 3-1. Excepting EPA's NPDES permit for TOSES operation, all permits and approvals have been received.

Table 3-1. Federal and state permits and certifications for which applications have been submitted (TUSI 1982).

AGENCY	PERMIT TYPE	PERMIT #	STATUS
TDWR	Dam Construction Permit	#2958	Applied 5/20/74 Received 10/8/74
TDWR	Water Rights Contract	#CP-255	Applied 6/21/74 Received 10/8/74
TDWR	Waste Control Order	#01986	Applied 4/18/75 Received 2/25/76
PUC	Certificate of Convenience and Necessity	NA	Received 8/30/76
COE	Section 404 Permit	NA	Not Required
TACB	Construction Permit Boilers 1 & 2	C-3992 C-3993	Applied 12/31/75 Received 2/28/78
TACB	Construction Permit Ash Handling System	C-3995	Applied 12/29/75 Received 6/22/79
TACB	Construction Permit Lignite Handling System	C-3994	Applied 12/29/75 Received 6/22/79
EPA	PSD Permit	PSD #TX-32	Applied 6/20/77 Received 9/22/77
FAA	Stack Lighting Approval	78-ASW-705-OE 78-ASW-706-OE	Received 5/4/78
TDWR	Solid Waste Disposal Facilities Registration	Registration #32043	Applied 12/30/80 Received 6/11/81
EPA	NPDES Permit (Mine)	EPA ID# TX076465	Applied December 5, 1977 Received November 28, 1981
EPA	NPDES Permit (Station)	EPA ID# TX0668021	Applied June 3, 1975 Received - No

ACRONYMS

COE - Corps of Engineers
FAA - Federal Aviation Administration
TACB - Texas Air Control Board
EPA - Environmental Protection Agency
PUC - Public Utility Commission
TDWR - Texas Department of Water Resources

CHAPTER 4.0

PURPOSE AND NEED

4.0 PURPOSE AND NEED

4.1 NEED FOR THE PROPOSED PROJECT

Texas Power & Light Company (TP&L) and Aluminum Company of America (ALCOA) propose to build and operate a lignite-fired mine-mouth steam electric generating station in Robertson County, Texas. Twin Oak Steam Electric Station (TOSES) currently is being designed and constructed by Texas Utilities Services Inc. (TUSI) and will be operated by Texas Utilities Generating Company (TUGCO). The TOSES, currently under construction approximately 11 miles north of Franklin, Texas, is being constructed for the following reasons:

- There is growing demand for electrical energy in the TP&L and Texas Utility Company System (TUCS) service area.
- Available power supply (i.e., generating capacity) within the existing TP&L and TUCS system is limited;
- Efficient use of fossil fuels (i.e., lignite), requires that mine mouth plants be located at the fuel source.
- ALCOA has needs for large power supplies (details confidential).

These reasons are explained briefly in the paragraphs below.

4.1.1 National Energy Policy

United States' dependence upon foreign oil has become a national concern. Increases in oil prices and the threat of embargos have created a need for the US to develop a program for decreasing the nation's dependence on foreign oil by developing synthetic and alternative fuels, as well as producing and utilizing electrical energy from these alternatives sources where possible. The Federal Fuel Use Act of 1978, as amended, specifically prohibits use of fuel oil and natural gas as primary boiler fuels in electric generating stations built after May 1979.

Two alternative fuels expected to replace gas and fuel oil as primary boiler fuels are lignite/coal and nuclear. Projections made by the U.S. Department of Energy (1978) indicate that use of lignite/coal as a primary fuel source for electric generating stations will increase from 9.7% in 1977 to 28.4% in 1999.

4.1.2 Projected Electrical Demand

Electrical demand in the TP&L service area has grown at an annual rate of 7% during the last decade. Although the public has become more conscientious about energy conservation, load projections developed by TP&L indicate demand growth near 5% for the immediate future. A similar history and projection of demand growth applies to the TUCS, of which TP&L is an affiliate. Demand growth for TUCS has been more than 5% for the past decade and is projected to be only modestly below that figure in the next few years. Tables 4.1 and 4.2 include a list of projected demands and associated generating capacity for TP&L and TUCS respectively for the years 1985 to 1990.

4.1.3 Projected Generating Capability

An electrical utility must have the capability to generate sufficient electricity to satisfy the peak hour demand of the service area and maintain an adequate reserve. The Electric Reliability Council of Texas[1] has established reliability planning criteria which include minimum generating capacity reserve. The planning criteria of ERCOT state that "sufficient generating capacity will be provided, as nearly as practicable, to insure a reserve of at least 15% of the forecasted maximum hour demand of the Interconnected Systems." However, with the increased use of less reliable lignite and coal fired units, a higher reserve capacity may be required in the future. Other reliability councils have recognized the need to increase minimum reserve levels to 20% or greater.

In 1981, TP&L reported a total capability of 7,904 MW at the time of the summer maximum demand, and TUCS showed a capability of 17,412 MW. If no additional units are added, the installed capability will cease to provide 15% reserve for TP&L and TUCS by 1985 if anticipated load growth continues. Additional

---

[1] The Electric Reliability Council of Texas (ERCOT) is one of nine regional councils which make up the National Electric Reliability Council (NERC). The councils represent all segments of the electric utility industry and include essentially all of the electric power systems in the contiguous United States and parts of Canada. NERC was formed on a voluntary basis by the electric industry in 1968 with the goal of improving the reliability and adequacy of the bulk power supply of the electric systems in North America.

Table 4-1. Projected demand for electrical power in TP&L service area versus TP&L generating capability with and without TOSES during the years 1985 through 1990.

Year	Peak Demand (MW)	Net Capacity[1][3] with TOSES (MW)		Net Capacity[2][3] without TOSES (MW)	
		(MW)	(% Reserve)	(MW)	(% Reserve)
1985	7,320	8,310	13.5	8,310	13.5
1986	7,700	8,723	13.3	8,723	13.3
1987	8,100	8,723	7.7	8,723	7.7
1988	8,520	9,335	9.6	8,723	2.4
1989	8,960	9,485	5.9	8,873	(1.0)
1990	9,410	10,739	14.1	9,514	1.1

---

[1] Assumes purchased of:

95 MW	in 1985
95 MW	in 1986
96 MW	in 1987
145 MW	in 1988
145 MW	in 1989
195 MW	in 1990

[2] Assumes purchases of 95 MW in 1985-1990.

[3] Includes the 2-1/6% of Comanche Peak that Tex-La has agreed to purchase.

Source: Adapted from Texas Utilities Services Inc. 1980. Environmental information document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas, Texas, variously paged.

Table 4-2. Projected demand for electrical power in the TUCS service area versus the company's generating capability with and without TOSES during the years 1985 through 1990.

Year	Peak Demand (MW)	Net Capacity[1][3] with TOSES (MW)	Net Capacity[1][3] with TOSES (% Reserve)	Net Capacity[2][3] without TOSES (MW)	Net Capacity[2][3] without TOSES (% Reserve)
1985	15,590	18,934	21.5	18,934	21.5
1986	16,300	19,969	22.5	19,969	22.5
1987	17,040	19,969	17.2	19,969	17.2
1988	17,805	20,582	15.6	19,969	12.2
1989	18,600	21,187	13.9	20,574	10.6
1990	19,410	23,184	19.4	21,959	13.1

---

[1] Assumes purchased of:
95 MW in 1985
95 MW in 1986
96 MW in 1987
145 MW in 1988
145 MW in 1989
195 MW in 1990

[2] Assumes purchases of 95 MW in 1985-1990.

[3] Includes the 2-1/6% of Comanche Peak that Tex-La has agreed to purchase.

Source: Adapted from Texas Utilities Services Inc. 1980. Environmental information document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas, Texas, variously paged.

generating capacity is needed to meet the 15% reserve level. New units currently planned by TP&L and TUCS are as follows, with shares of each to be owned by TP&L:

PLANT/UNIT	COMMERCIAL OPERATION	SHARE TO BE OWNED BY TP&L[1]
Comanche Peak/1	1984	33 2/3%
Comanche Peak/2	1985	33 2/3%
Twin Oak/1	1988	75% [2]
Twin Oak/2	1990	75% [2]
Forest Grove	1989	20%
Martin Lake/4	1990	32.5%
Unannounced Unit	1990	53%

---

[1] Share subject to change on later units.

[2] 75% of capability and 70% of cost.

Table 4.1 for TP&L and Table 4.2 for TUCS indicate capability and reserve anticipated for TP&L and TUCS respectively assuming the above-listed units are constructed. Also shown are conditions without the proposed TOSES. The reserve capacity of TP&L alone is inadequate beginning in 1985, and actually becomes negative in 1989 if TOSES is not constructed. Reserve for TUCS reaches a minimum of 13.9% in 1989 or 10.6% without the proposed TOSES.

Ultimate responsibility of deciding whether or not a new power plant is needed in Texas rests with the Public Utility Commission (PUC). The PUC issued a Certification of Convenience and Necessity for the proposed TOSES on 30 August 1976.

4.1.4 Fuel Requirement (Need for Mine)

The operation of the associated 33,000 acres of surface lignite mines is necessary to provide fuel for the proposed TOSES. Approximately 7.9 million tons of lignite per year will be required throughout the life of the project. Other fuel sources for power generation were evaluated by the applicant. A complete discussion and comparison of other fuel sources is included in Chapter 5.0, "Description of Alternatives," of this document.

4.2 PURPOSE OF THE EIS

In order to discharge wastewater from the proposed TOSES, TUSI must obtain a National Pollutant Discharge Elimination System (NPDES) permit from EPA as mandated by the Clean Water Act. Issuance of such a permit has been determined a "Major Federal Action" with significant impacts on the human environment. In accordance with the requirements of the National Environmental Policy Act, EPA has prepared this draft EIS.

CHAPTER 5.0

DESCRIPTION OF ALTERNATIVES

5.0 DESCRIPTION OF ALTERNATIVES

TUSI evaluated many alternatives during the development of their proposed TOSES project. EPA also has evaluated its permitting alternatives concerning wastewater discharge from the proposed project. This chapter presents a summary of:

- The "no action" alternative;
- Alternatives evaluated by TUSI for the TOSES and associated transmission facilities;
- A more detailed description of the proposed TOSES project; and
- Permitting alternatives available to EPA and other permitting agencies.

Throughout this chapter and the remainder of this report the terms "project site," "mine site," and "project area" will be used. These terms are defined as follows:

- Project site - an area of approximately 3,393 acres which includes the proposed TOSES plant island and the Twin Oak Reservoir.
- Mine sites - three discrete areas of approximately 33,000 acres (combined) overlying the lignite reserves to be mined in association with the proposed TOSES.
- Project area - an area of approximately 2,827 square miles consisting of all land within 30 miles of the proposed TOSES plant site.

5.1 NO ACTION ALTERNATIVE

Since construction of TOSES is underway, no action by the permit applicant is a moot discussion. While no action could be implemented by the permit applicant by discontinuing construction and completion of TOSES, certain impacts such as vegetation removal, habitat disturbance, topography changes, etc. have already occurred. It is recognized that should EPA deny a NPDES permit for the project, no action could also result. Even though the company could possibly redesign the plant to include no wastewater discharge, such action would have prohibitive costs.

Regardless of the permit decision on TOSES, TUCS would develop and operate a commercial lignite mine utilizing their lignite reserves in Robertson County. This means that for 35 years conditions in the project area would change due to operation of the lignite mine. In addition, conditions in the project area are expected to change due to construction and operation of Houston Lighting and Power's Limestone Electric Generating Station and associated Jewett Mine in Freestone, Limestone, and Leon Counties (scheduled for 1985), and due to the expansion of TUCS's Big Brown Electric Generating Station in Freestone County (scheduled for 1990).

If the no action alternative is implemented, demand for electrical power in the TUCS service area will have to be reduced or met by some other means. In general, one of two major secondary effects outside of the project area may result from taking no action:

- A steam electric station (SES) in an area other than the project area will be initiated. A new SES will cost about $1473/KW as opposed to a cost of $1,012/KW for Twin Oak.
- The demand for additional electricity in the TUCS service area will be satisfied by TUCS (increased reliance) on more expensive gas fired generation.

5.2 PROJECT ALTERNATIVES

Many operational and/or design alternatives for satisfying or altering the need for power in the TUCS service area were evaluated by the permit applicant. This section summarizes the review and evaluation of project alternatives conducted by the permit applicant, including:

- Power sources and management techniques;
- Fuel sources and generating methods;
- Project sites; and
- Transmission facilities.

5.2.1 Power Sources and/or Management Techniques

The permit applicant evaluated five structural and non-structural alternatives for satisfying part or all of the demand for electric power in the TUCS service area. Table 5-1 lists these five methods and identifies the advantages and disadvantages of each. Based upon a review of the information summarized in Table 5-1, the permit applicant concluded that construction of a new 1,500 to 3,000 MW SES was the only way to meet the requirements of the Federal Fuel Use Act and still have the generating capability to meet projected demands.

5.2.2 Fuel Sources

Once it was determined that a new 1,500 to 3,000 MW SES would be built to help maintain the desired generating capacity for the TUCS system, an evaluation was made of various fuels available for use. Table 5-2 summarizes the fuels evaluated by TUSI. The permit applicant concluded that an SES fueled by Texas lignite was the best alternative to meet project goals and schedules.

5.2.3 Power Plant Sites

5.2.3.1 Selection of Preliminary Sites

Once Texas lignite was selected as a fuel, the location of alternative sites for a new 1,500 to 3,000 MW SES was limited by the fact that TUCS owned lignite reserves in Robertson County, Texas. Since economics dictated that TUCS use its own lignite reserves as fuel for the new SES, criteria for designating and evaluating alternative power plant sites were established that incorporated the fact that the new SES would be located in central Texas, somewhere in or near Robertson County (Table 5-3). Figure 5-1 illustrates the location of 11 alternative power plant and/or reservoir sites which were selected by the permit applicant for initial review and evaluation.

Table 5-1. Summary evaluation of alternatives for satisfying electric power demand.

- PURCHASING POWER

  Pro: Efficient use of the generating capacity of existing SESs.

  Con: TUCS is already contracted to purchase other available power (see Table 4-1). Power from other systems is not available, since it reduces the capabilities of other companies to meet their own peak demands. In addition, other companies are retiring older gas/ oil-fired units in response to the Federal Fuel Use Act making surplus power for purchase unavailable.

- VOLUNTARY CONSUMER CONSERVATION

  Pro: Extends life of existing SESs and delays need for new SESs (assuming conservation program is successful).

  Con: Consumer conservation in the past has not dramatically changed the current trend of increasing demand. Continuing rapid growth in the "sun-belt" is expected to cause increases in demand that will greatly exceed decreases due to conservation efforts. In addition, adverse or unseasonable weather often causes the public to abandon conservation efforts in favor of personal comfort.

- FUEL CONVERSION AT EXISTING PLANTS

  Pro: Use of existing facilities as an available resource.

  Con: Converting gas/oil-fired plants to burn coal/lignite is expensive. Burning coal/lignite requires 20 to 25% more air and creates large quantities of ash. Existing boilers must be downrated and retrofitted with bottom ash and fly ash controls. Coal/lignite delivery and conveyance systems must be added in space that does not exist. Generating capacity of a converted unit is reduced by 40 to 50%, thus conversion of existing units would in effect decrease the overall generating capabilities of TUCS's facilities.

Table 5-1. Summary evaluation of alternatives for satisfying electric power demand (concluded).

- CONVERSION OF PEAKING UNITS TO BASELOAD OPERATION

Pro:	Use of existing plants as an available resource.
Con:	Requires use of maximum capabilities of existing units just to meet average conditions. Operation of peaking units 100% capacity is inefficient. Sufficient fuel to operate peaking units as baseload facilities is expensive and will not be available. System is not able to meet any peak demands, potentially resulting in frequent brown-outs or black-outs.

- CONSTRUCTION OF NEW 1500 MW SES

Pro:	Enables TUCS to curtail use of oil/gas as boiler fuels (per Federal Fuel Use Act) and still meet anticipated demand. Provides new, efficient facilities that incorporate state of the art pollution control equipment. Adds flexibility and reliability to TUCS's electric generating capabilities. Provides maximum generating capability per dollar invested. Provides beneficial effects to local communities where new facilities are constructed.
Con:	Requires use of financial, labor, material, and natural resources which are irretrievable. May result in adverse effects in project area which cannot be mitigated or eliminated.

Source: Adapted from Texas Utilities Services Inc. 1980. Environmental Information Document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas TX, variously paged.

Table 5-2. Summary evaluation of alternative fuel sources for the proposed 1,500 to 3,000 MW SES.

- NUCLEAR POWER

Pro: Commercially available technology; no particulate or sulfur emission controls required.

Con: Design and construction unable to meet project constraints (i.e., needed on-line by 1988-1990); current issues concerning reliability, safety, and public acceptability; requires handling and disposal of radioactive by-products.

Fission Breeder Reactor: Not commercially available.
Fusion Reactor: Not commercially available.

- FOSSIL FUEL

Texas Lignite

Pro: Commerically proven technology; conforms to project timing; multiple sources for fuel; economically attractive fuel (approximately $7.20/ton); company owned lignite reserve in Robertson County, TX.

Con: Emission control requirements for particulates and sulfur.

Fuel Oil

Pro: Commerically proven technology; conforms to project timing; intermediate level of emission controls.

Con: Long-term availability and cost is uncertain;

Natural Gas

Pro: Commercially proven technology; conforms to project timing; low emission control levels required.

Con: High cost.

Western Coal

Pro: Commerically proven technology; conforms to project timing.

Con: Expensive to mine and transport (approximately $30/ton); subject to disruption of fuel delivery due to strikes by transportation workers, and to natural or man-made disasters damaging railroad transportation facilities; emission controls required.

Table 5-2. Summary evaluation of alternative fuel sources for the proposed 1,500 to 3,000 MW SES (concluded).

- OTHER SOURCES

Geothermal

Pro: Potential sources exist in Gulf Coast regions of Texas and Louisiana.

Con: Commercial utilization does not meet project schedule constraints; economic viability of technique in service area is uncertain; distance.

Solar Energy

Pro: Untapped, inexhaustable resource; no emissions from use.

Con: Technology is not commerically proven.

Source: Adapted from Texas Utilities Services Inc. 1980. Environmental Information Document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas, Texas, variously paged.

Table 5-3. Criteria for the selection and evaluation of alternative SES sites.

- Near the TUCS-owned lignite reserves, in order to limit fuel transportation distance and cost.
- Near long-term sources of water that are economically available.
- Adequate available land.
- Compatible with alternative cooling systems, including once-through cooling, cooling towers, and/or cooling reservoirs.
- Accessible to and near local transportation facilities.
- Acceptable make-up water source, and receiving water body suitable for discharge of plant wastewater(s).
- Environmentally compatible with construction and operation of a 1,500-3,000 MW SES.

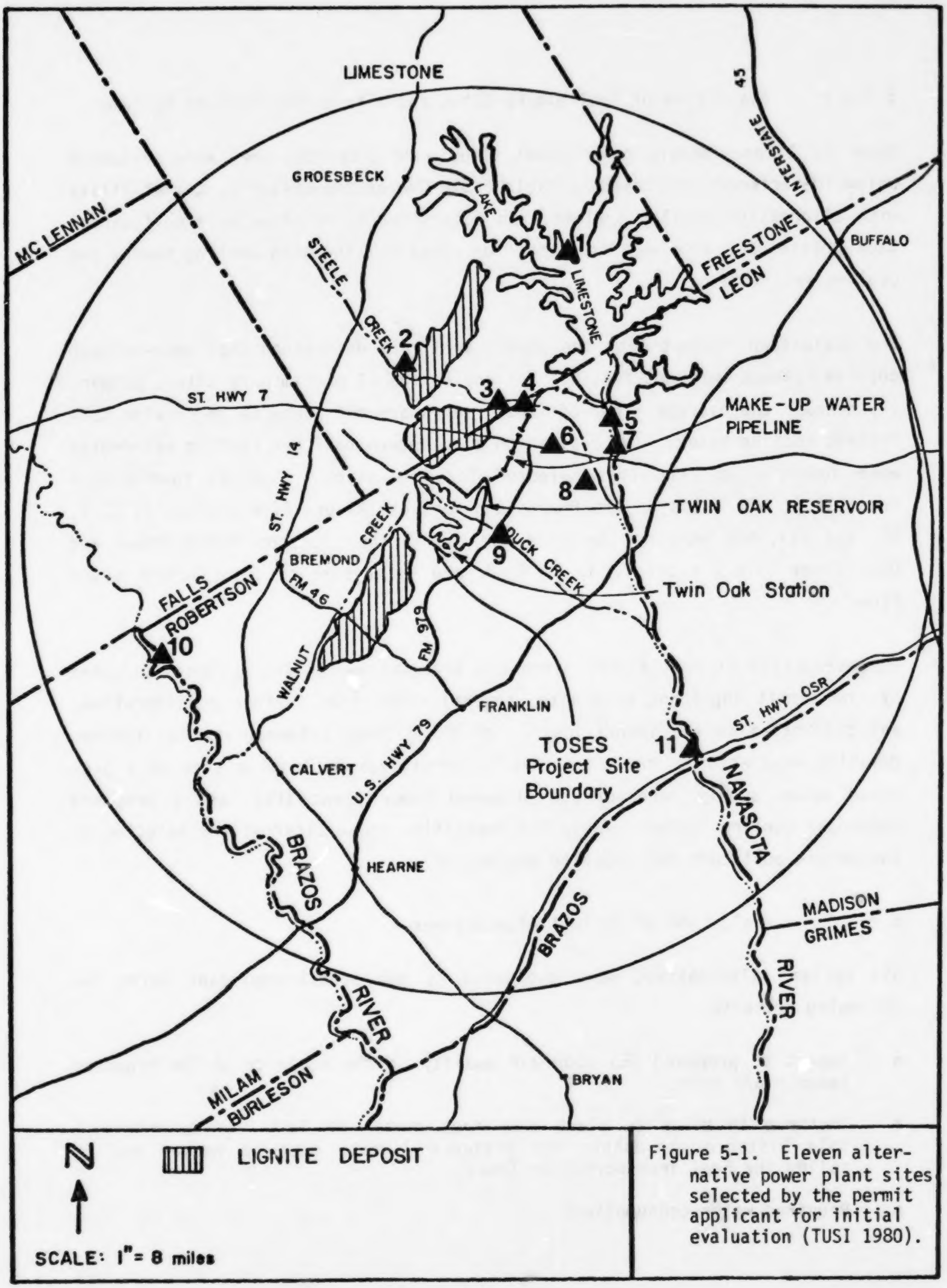

LIMESTONE
INTERSTATE 45
GROESBECK
LAKE
LIMESTONE
MC LENNAN
STEELE CREEK
FREESTONE
LEON
BUFFALO
1
2
3
4
5
6
7
8
9
10
11
ST. HWY 7
MAKE-UP WATER PIPELINE
ST. HWY 14
TWIN OAK RESERVOIR
CREEK
DUCK CREEK
BREMOND
Twin Oak Station
FALLS
ROBERTSON
FM 46
FM 979
WALNUT CREEK
FRANKLIN
ST. HWY OSR
TOSES Project Site Boundary
CALVERT
U.S. HWY 79
NAVASOTA
BRAZOS
HEARNE
BRAZOS
MADISON
GRIMES
RIVER
RIVER
MILAM
BURLESON
BRYAN
N
LIGNITE DEPOSIT
SCALE: 1" = 8 miles

Figure 5-1. Eleven alternative power plant sites selected by the permit applicant for initial evaluation (TUSI 1980).

5.2.3.2 Evaluation of Preliminary Sites and Alternative Cooling Systems

Once the 11 preliminary power plant sites were selected, they were evaluated using the criteria presented in Table 5-3. One of the criteria, compatibility with alternative cooling systems, was determined to be of major significance. Each preliminary site was evaluated for compatibility with cooling towers and cooling reservoirs.

The evaluation conducted by the permit applicant determined that once-through cooling systems were not feasible for any of the 11 preliminary sites, primarily because the average flows of Texas rivers are not adequate to provide sufficient cooling water. The evaluation also determined that cooling reservoirs were feasible at all sites selected for evaluation. Cooling towers were feasible at all sites on the Brazos and Navasota Rivers (i.e., sites 1, 5, 7, 10, and 11), but were not feasible for use at the sites on Steele Creek and Duck Creek (i.e., sites 2, 3, 4, 6, 8, and 9) because of insufficient water flow.

The evaluation of preliminary sites and alternative cooling systems conducted by the permit applicant eliminated several sites from further consideration, and culminated in the identification of six optimal alternatives for further detailed evaluation. The six optimal alternatives included a site of a proposed water supply reservoir, a proposed power plant site, and a proposed condenser cooling system. Table 5-4 identifies those alternatives selected by the permit applicant for detailed evaluation.

5.2.3.3 Evaluation of Optimal Alternatives

Six optimal alternatives were evaluated by the permit applicant using the following criteria:

- Impact of proposed SES upon air quality in the vicinity of the proposed power plant site;
- Distance in miles to plant site from center of TUCS lignite reserves; this distance represents the distance lignite must be hauled and is called the Fuel Transportation Index;
- Required water consumption;

Table 5-4. Optimal power plant and reservoir site alternatives selected for detailed evaluation.

Alternative	Location of Water Supply Reservoir[1]	Location of Power Plant Site[1]	Proposed Condenser Cooling System
Ia	Site 10	Site 9	Cooling Reservoir at Site 9
Ib	Site 10	Site 3	Cooling Reservoir at Site 3
IIa	Site 5	Site 5	Cooling Reservoir at Site 5
IIb	Site 5	Site 5	Cooling Towers at Site 5
IIIa	Site 5	Site 9	Cooling Reservoir at Site 9
IIIb	Site 5	Site 3	Cooling Reservoir at Site 3

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[1] Refer to Figure 5-1 for site locations.

Source: Adapted from Texas Utilities Services Inc. 1980. Environmental information document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas, Texas, variously paged.

- Cost of make-up water supply; and
- Cost of condenser cooling system.

Table 5-5 lists the results of the permit applicant's detailed evaluation of the optimal site alternatives for a 1,500 to 3,000 MW SES. The evaluation, combined with correspondence between the Brazos River Authority (BRA) and TUCS, concluded that water rights for make-up cooling water were not available from the Brazos River; thus, Alternatives Ia and Ib were eliminated from further consideration.

A comparison of the group II alternatives (i.e., Alternatives IIa and IIb) with the group III alternatives indicated that the group II alternatives had higher Fuel Transportation Indexes, required more make-up water, and had higher make-up water costs and higher cooling system costs. In addition, further air quality impact assessments indicated the group II alternatives (with proposed 3,000 MW SES's) would cause allowable PSD increments to be exceeded; thus, the group II alternatives were unacceptable from an air quality standpoint. Alternative IIIa and IIIb were selected as the most desirable of the six optimal alternatives.

Due to the shorter fuel haul distance, TUCS selected Alternative IIIa as the proposed 1,500 MW Twin Oak SES project. Alternative IIIb, named Oak Knoll SES, was deferred for possible later development should future power demands so dictate.

5.2.4 Transmission Facilities

Two basic types of transmission facilities are available: (1) underground, and (2) overhead. Although an underground transmission line is potentially more environmentally acceptable than an above-ground line (at least after construction), costs and construction difficulties associated with an underground system typically are prohibitive. Underground transmission facilities therefore were not considered by the permit applicant to be a feasible alternative. TUCS selected overhead facilities using wood H-frame towers or latticed steel towers for all transmission facilities associated with the proposed TOSES project.

Table 5-5. Detailed evaluation of optimal site alternatives for a 1,500 to 3,000 MW SES.

Alternative	Description[1]	Air Quality Impact	Fuel Transportation Index (Miles)	Water Consumption (Ac-Ft/Yr)	Water Supply Capital Cost[2] (Millions)	Cooling System Capital Cost[2] (Millions)	Comment
Ia	1500 MW Station on Duck Creek at Site 9; reservoir cooling; make-up water from a channel dam on the Brazos River at Site 10.	Acceptable	4	13,200	23.0	9.3	Does not include Brazos River water cost.
Ib	1500 MW Station on Steele Creek at Site 3; reservoir cooling; make-up water from a channel dam on the Brazos River at Site 10.	Acceptable	7.7	11,900	23.0	9.3	Does not include Brazos River water cost.
IIa	3000 MW Station on Navasota River at Site 5; reservoir cooling.	Unacceptable	13.9	25,100	39.4	18.6	Water cost included; longest fuel haul.
IIb	3000 MW Station on Navasota River at Site 5; cooling towers.	Unacceptable	13.9	36,800	39.4	42.6	Water cost included; longest fuel haul.
IIIa	1500 MW Station on Duck Creek at Site 9; reservoir cooling; make-up water from Navasota River Site 5.	Acceptable	4	13,200	35.9	9.3	Water cost included.
IIIb	1500 MW Station on Steele Creek at Site 3; reservoir cooling; make-up water from Navasota River Site 5.	Acceptable	7.7	11,900	36.0	9.3	Water cost included.

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[1] See Figure 5.1 for location of sites.

[2] In terms of 1979 dollars.

Source: Adapted from Texas Utilities Services, Inc. 1980. Environmental Information document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas, Texas, variously paged.

Alternative transmission routes were selected by the permit applicant using the following criteria or "goals":

- maximize use of existing corridors;
- maximize use of TUCS-owned lands
- minimize line length;
- capital investment;
- identify and avoid population centers;
- avoid mining areas; and
- minimize potential impact on individual tracts of land.

Alternative routes selected for evaluation are designated as segments 5/5A and 6/6A on Figure 5-2. Transmission line segment 1 is a short (8-mile) segment that will involve a new corridor; however, due to its short length, the permit applicant determined it was not reasonable to investigate or evaluate an alternate route. Transmission line segments 2 through 4 follow existing corridors exclusively, thus alternate routes that would require new corridors (i.e., new easements) were not considered for line segments 2 through 4. Table 5-6 is an evaluation of the primary and alternative routes for transmission line segments 5 and 6. In each case, the primary route (5 and 6) is shorter, requires less land for the new corridor, and contains fewer major road crossings than the alternate route (5A and 6A). Therefore, the permit applicant selected routes 5 and 6 for utilization with the proposed TOSES.

5.3 DESCRIPTION OF THE PROPOSED PROJECT

Texas Utilities Generating Company's proposed 1,500 MW Twin Oak SES is currently being constructed in Robertson County, Texas (Figure 5-3). A dam on Duck Creek to create a new 2,330-acre cooling reservoir immediately north of the power plant site is nearing completion or is completed. Make-up water for the reservoir will be provided by a pumping station on Lake Limestone and conveyed through a pipeline to the reservoir. The gently rolling terrain of the project area lies partially in the Navasota River watershed and partially in the Brazos River watershed. Access to the TOSES site is provided via State Highway 979 at a point 11 miles north of Franklin, Texas. Three new

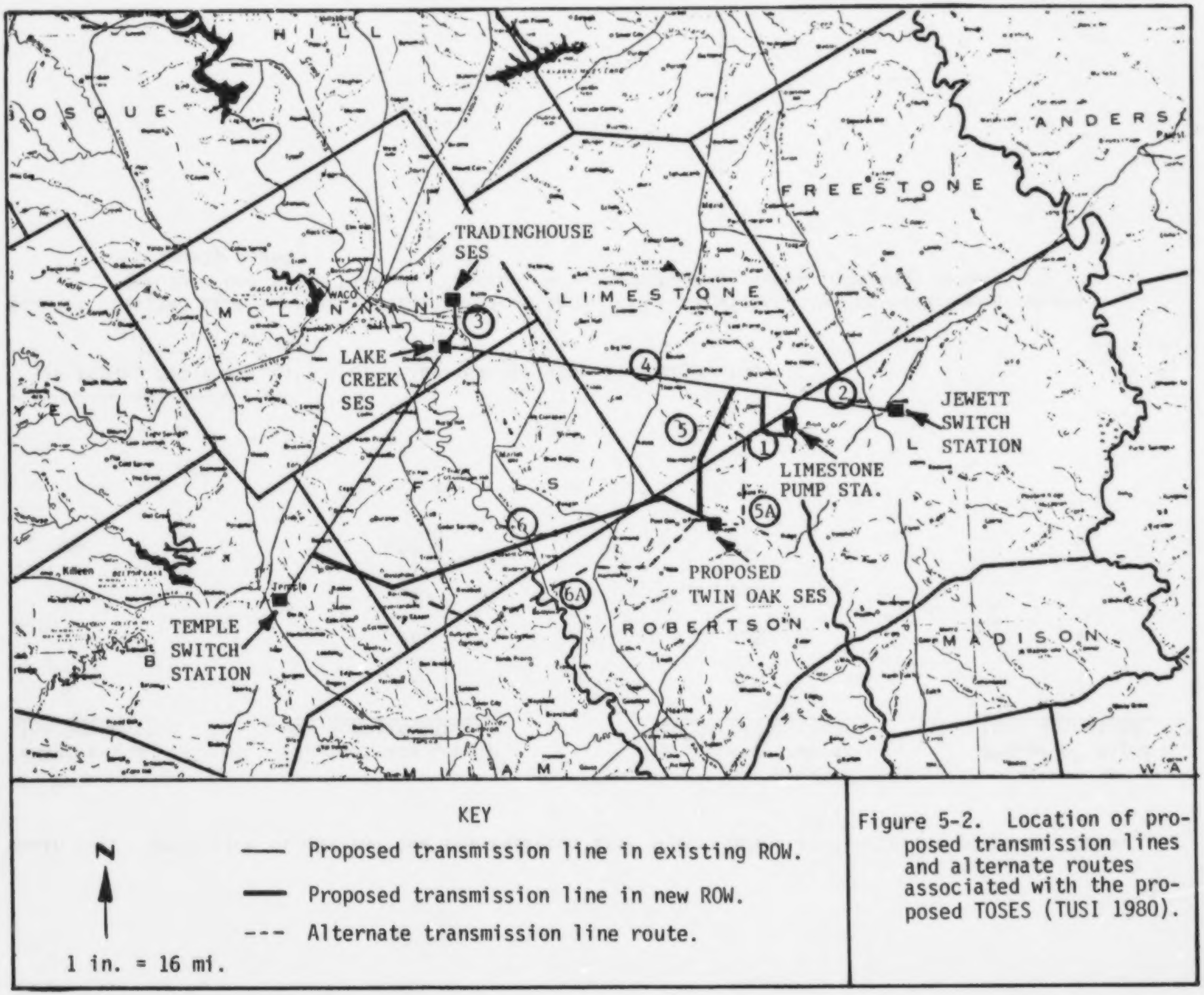
HILL
BOSQUE
ANDERS
FREESTONE
LIMESTONE
MCLENNAN
WACO
FALLS
ROBERTSON
MADISON
MILAM
BELL
WA
TRADINGHOUSE SES
LAKE CREEK SES
JEWETT SWITCH STATION
LIMESTONE PUMP STA.
PROPOSED TWIN OAK SES
TEMPLE SWITCH STATION
Temple
Killeen
1
2
3
4
5
5A
6
6A
KEY
Proposed transmission line in existing ROW.
Proposed transmission line in new ROW.
Alternate transmission line route.
N
1 in. = 16 mi.

Figure 5-2. Location of proposed transmission lines and alternate routes associated with the proposed TOSES (TUSI 1980).

Table 5-6. Evaluation of alternative transmission line routes associated with the proposed TOSES.

Transmission Line Segment*	Approximate Length of Segment (Miles)	Approximate Area of New Corridor (Ac)	Number of Major Road Crossings
5	17	474	3
5A	21	585	4
6	48	931	4
6A	50	970	8

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* See Figure 5-2 for location of these transmission line segments.

Source: Adapted from Texas Utilities Services Inc. 1980. Environmental information document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas, Texas, variously paged.

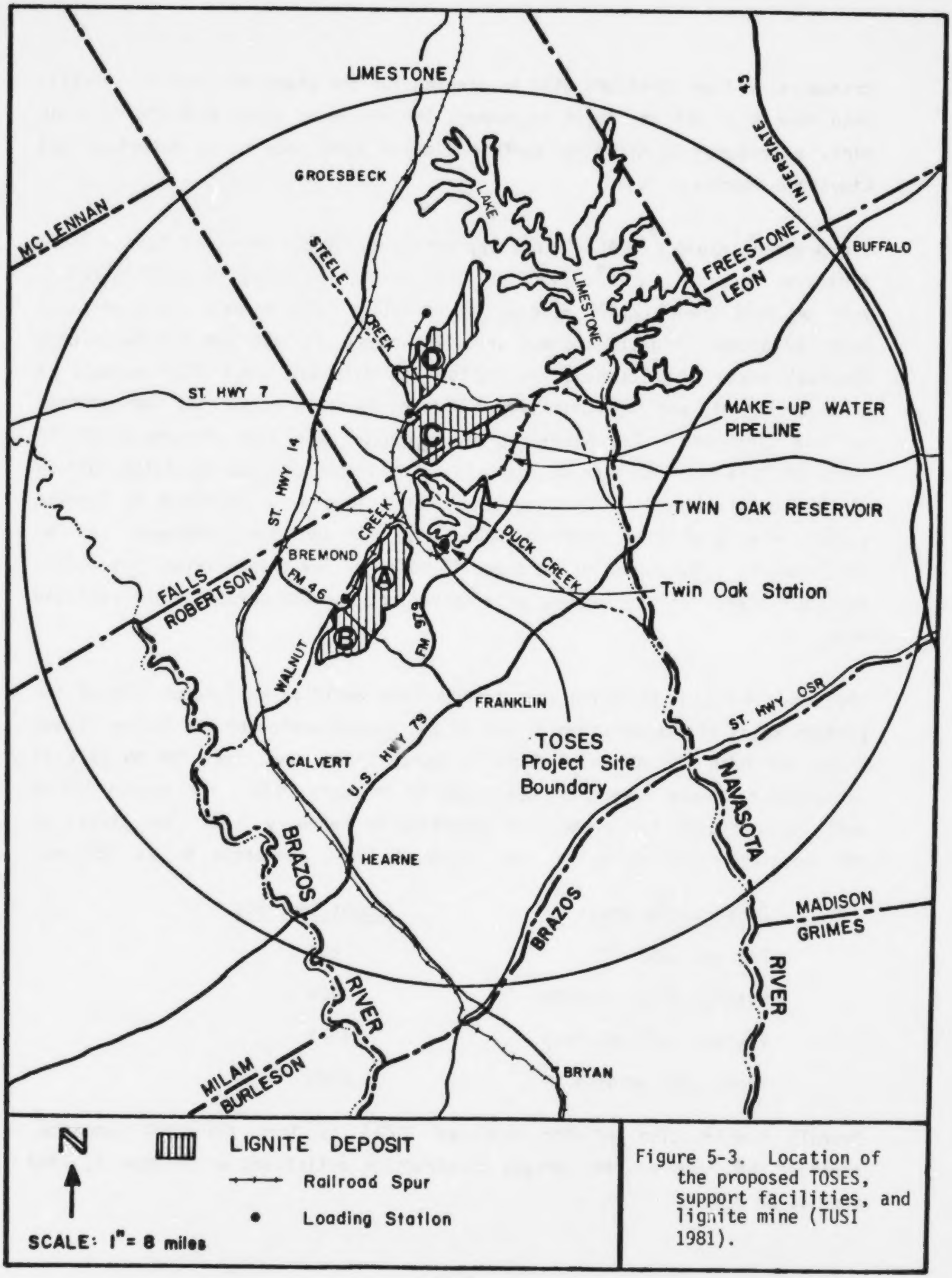
LIMESTONE
GROESBECK
INTERSTATE 45
MC LENNAN
LAKE
LIMESTONE
STEELE CREEK
FREESTONE
LEON
BUFFALO
D
C
ST. HWY 7
MAKE-UP WATER PIPELINE
ST. HWY 14
TWIN OAK RESERVOIR
CREEK
BREMOND
A
DUCK CREEK
Twin Oak Station
FALLS
ROBERTSON
FM 46
B
FM 979
WALNUT
FRANKLIN
TOSES Project Site Boundary
U.S. HWY 79
ST. HWY OSR
CALVERT
NAVASOTA
BRAZOS
HEARNE
BRAZOS
MADISON
GRIMES
RIVER
RIVER
MILAM
BURLESON
BRYAN
N
LIGNITE DEPOSIT
Railroad Spur
Loading Station
SCALE: 1" = 8 miles

Figure 5-3. Location of the proposed TOSES, support facilities, and lignite mine (TUSI 1981).

transmission line corridors will be cleared for the proposed project. A railroad spur also will be built to connect the new power plant with the Twin Oak mine, a proposed 33,000-acre surface lignite mine located in Robertson and Limestone Counties, Texas.

The proposed project will disturb approximately 38,826 acres of land. Total land area required for the TOSES is 3,393 acres, including the cooling reservoir on Duck Creek (2,330 acres), plant island (250 acres), plant entrance road (18 acres), lignite storage area (25 acres), fly ash and scrubber sludge disposal areas (570 acres), and bottom ash disposal areas (200 acres). A small amount of land (approximately 1.0 acre) is included for the pump station on Lake Limestone. The nearby surface lignite mine will disturb about 750 acres of land per year for 35 years in a continuous process involving surface mining, backfilling, and reclamation. Total land area disturbed by lignite surface mining will be about 33,000 acres. In addition, transport systems will require 1,502 acres of land for 73 miles of new tranmsission line corridor, 109 acres for the make-up water pipeline, and 822 acres for the railroad spur.

The Texas Air Control Board and the EPA were notified on 3 March 1978 of the planned start of construction of the TOSES. Construction of the boiler foundations for both 750 MW units began in March 1978. The first 750 MW unit is scheduled to begin commercial operation in February 1988. The second 750 MW unit is scheduled for commerical operation in February 1990. The status of the ongoing construction of the proposed TOSES currently is as follows:

Construction Phase	Amount Complete
Dam and reservoir	95%
Make-up water pipeline	90%
Freight railroad spur	100%
Plant site grading	100%

Overall construction of the proposed TOSES is less than 10% complete. Acreages for some of the various construction activities as of June 1, 1982 are listed below:

AREA	ACRES DISTURBED	ACRES REVEGETATED	ACRES PERMANENTLY REMOVED
Plant Island	250	180	70
Dam	206	200	6
Disposal Areas	140	70	70
Freight Railroad	550	480	70
Make-up Water Pipeline	125	122	70
Dragline Erection Pad	16	6	10
TOTAL	1287	1058	229

Twin Oak Reservoir will be filled about one year prior to plant start-up. At that time it will occupy 2,330 acres. As of 1 June 1982, about 800 acres in the reservoir basin had been cleared of large timbers; however, this area remains vegetated with grass and shrub species. About 300 acres are currently under water.

The following sections describe in detail the permit applicant's proposed project. Descriptions are given for: (1) the proposed Twin Oak SES and the associated reservoir; (2) the proposed transport systems, including the transmission lines, make-up water pipeline, and railroad; and (3) the proposed surface lignite mine.

5.3.1 Proposed TOSES and Cooling Reservoir

5.3.1.1 TOSES Power Generation

Figure 5-4 illustrates the proposed TOSES plant island. The power section for each 750 MW unit will consist of a boiler (steam generator), turbine generator, condenser, feedwater heaters, fans, pulverizers, pumps, and control equipment. The steam generator will be a combined circulation, balance-draft supercritical unit. Primary fuel will be pulverized lignite, with natural gas and #2 fuel oil used for the auxiliary boiler and main boiler start-up. The boiler will be designed to provide 5,700,000 lb/hr of steam at 1,010°F ± 10°F and 3,850 psi.

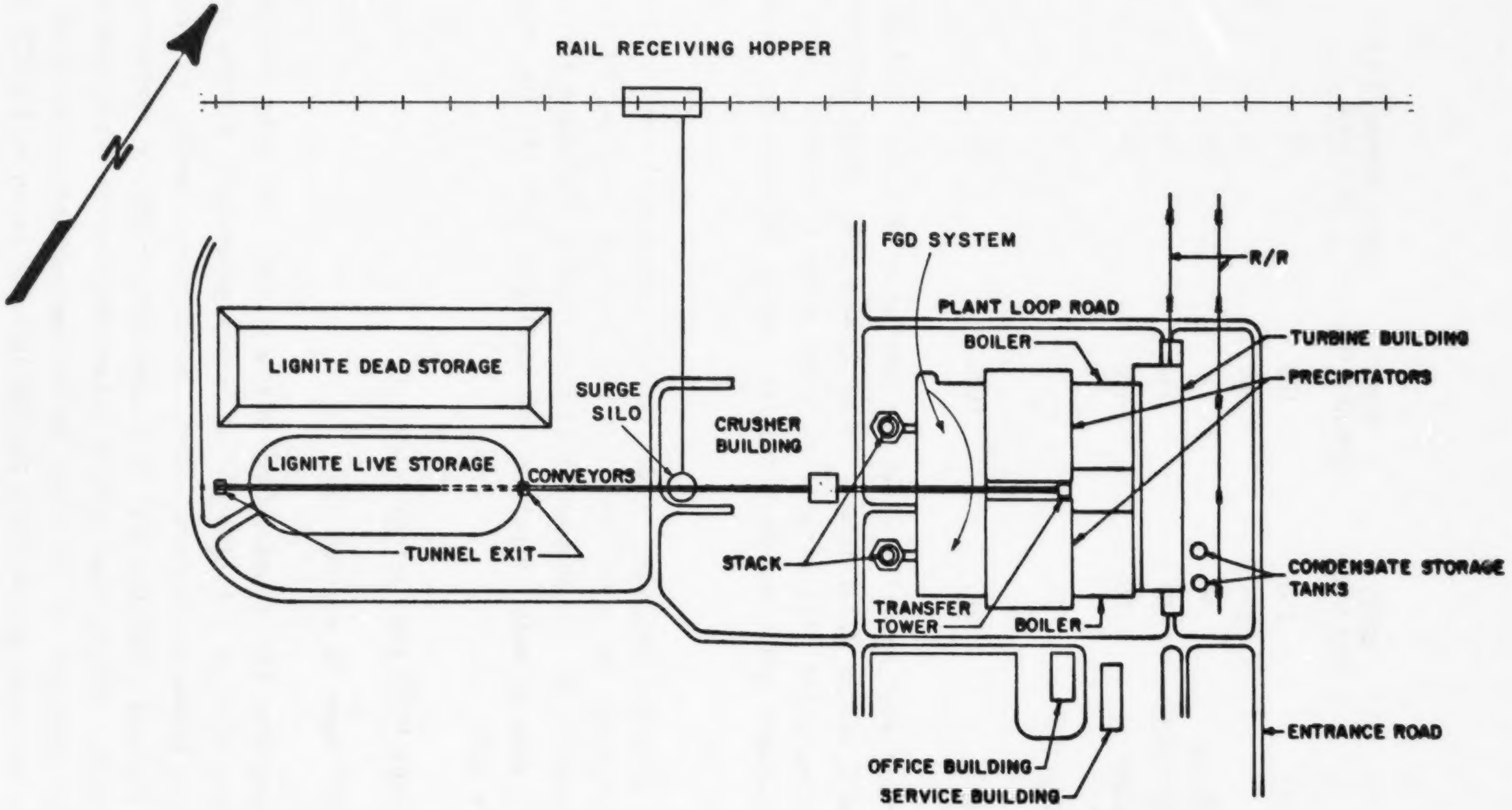
RAIL RECEIVING HOPPER
N
FGD SYSTEM
R/R
PLANT LOOP ROAD
BOILER
TURBINE BUILDING
PRECIPITATORS
LIGNITE DEAD STORAGE
SURGE SILO
CRUSHER BUILDING
LIGNITE LIVE STORAGE
CONVEYORS
TUNNEL EXIT
STACK
TRANSFER TOWER
BOILER
CONDENSATE STORAGE TANKS
ENTRANCE ROAD
OFFICE BUILDING
SERVICE BUILDING
0
200'
400'
800'

Figure 5-4. Schematic of proposed TOSES plant island (TUSI 1980).

The turbine generator will be a tandem-compound reheat unit with a single flow high pressure section opposed - flow, intermediate. The turbine will have a guaranteed rating of 734.5 MW at 3,600 RPM. The electrical generator will be an 843,000 Kva, 3,600 RPM, direct connected, 3 phase, 60 cycle, 24,000 volt conductor cooled synchronous unit.

The main condenser will be a 329,000 square foot, twin shell, single pressure, single pass surface unit. It will provide the mechanism for condensing steam exhausted from the turbine by transferring heat from the steam to the circulating water system. Water produced by condensing turbine exhaust steam will be collected in the condenser hotwell and pumped through a series of low pressure feedwater heaters to the deaerator. Feedwater heaters will extract steam from the turbine and heat feedwater on its return to the boiler. Discharge from the main feedwater pump will pass through two high pressure feedwater heaters and then to the boiler economizer section. Lignite from active storage will be fed to the crusher house by an inclined conveyor. From the crusher house, another conveyor will carry crushed lignite to the boiler surge bin which feeds each unit's storage silos. Lignite in the storage silos will be fed to each units pulverizers for processing prior to being fed to each boiler.

Primary air and forced draft fans will force combustion air into the boiler. Primary air will be sent through lignite pulverizers on its way to the boiler, which will provide a means for carrying pulverized lignite into the combustion area of the furnace. Each 750 MW unit will have ten 150,000 lb/hr pulverizers. As fuel is burned, approximately 20% of the ash will drop out as bottom-ash, while the other 80% will remain in the flue gas as fly ash. From the combustion area of the furnace, hot flue gas will travel across the superheat and reheat economizer tubes to create steam for the turbine. It then will travel through economizer air preheaters and into precipitators where fly ash will be removed.

A TOSES switchyard will be located between the east end of the turbine pedestal and the cooling pond shoreline. The area will be polygon shaped and enclose approximately 24 acres. It will be surfaced with crushed stone. A seven-foot chainlink fence topped with barbed wire will be located on the yard perimeter. The proposed design will provide for 26 to 345 KV circuit breakers for two generators and transmission lines; one 345/138 KV autotransformer; 11 to 138 KV circuit breakers; all necessary buswork, insulators, towers and support steel; instrument transformers; and one 60 x 20 foot metal building housing batteries, relay, supervisory, and control equipment.

5.3.1.2 TOSES Air Pollution Control System

Primary airborne emissions from the proposed TOSES will be boiler flue gases and lignite dust. Flue gases exiting the station's stacks will contain products from the combustion of lignite. In addition, some lignite dust is generated during lignite handling and processing. Sources of these emissions and the equipment which will be used to control the emissions are discussed in the paragraphs below.

Combustion of lignite in the boilers will produce flue gases which will be released to the atmosphere through two 450-foot stacks. Products from combustion of the lignite will include total suspended particulates (TSP), or ash, water (H_2O), carbon monoxide (CO) and carbon dioxide (CO_2), nitrogen (N_2) and its oxides (NO_x), oxygen (O_2), sulfur dioxide (SO_2), and hydrocarbons (HC).

Control of NO_x, CO, and HC emissions will require no extraneous control equipment. Controlled combustion techniques, principally staged combustion and minimization of excess air, constitute Best Available Control Technology (BACT) as defined by EPA. Boilers for both Twin Oak units which use these techniques are guaranteed by the manufacturer not to exceed new source performance standards (NSPS) for NO_x emissions. The TACB approved the proposed TOSES's boilers for NO_x control after BACT review on 3 January 1979.

About 80% of the TSP generated by the combustion of lignite will leave the boiler in hot flue gases. In excess of 99% of the TSP will be removed from the TOSES flue gases by electrostatic precipitators. Precipitators will be arranged to pass flue gases horizontally through a series of fields containing alternating parallel lanes of discharge frames and collecting plates. An electrical field will be developed between the negative discharge frames and the grounded collecting plates causing gas ions to adhere to dust and ash particles carried by the gases. Particles thus charged will be attracted to the positively charged collecting surfaces. Rapping devices periodically will strike the base of each collecting plate curtain and dislodge particles to be collected in hoppers. Each boiler at the proposed TOSES will have two electrostatic precipitators. Precipitators will be designed to treat 3,526,000 ACFM (actual cubic feet per minute) of air with a guaranteed specific collector area of 560 sq ft and a guaranteed efficiency of 99.75%. This particulate control system will insure that the EPA's and TACB's requirements for TSP levels are not exceeded. Precipitated fly ash will be collected in hoppers, slurried and pumped to a fly ash disposal area. BACT review of this proposed TSP control system was conducted and the system approved by the TACB on 13 February 1980.

Wet limestone scrubbers will be utilized to achieve compliance with NSPS for SO_2 emissions. Hot flue gas from the electrostatic precipitator outlet will be sent through four induced draft fans to the base of the scrubber spray towers. This gas then will be directed vertically upward where it will contact a limestone slurry through a series of spray levels. This contact is the mechanism that removes SO_2 from the flue gas as well as a portion of the residual fly ash from the precipitators. Limestone make-up slurry will be added to the reservoir at the bottom of the tower to maintain proper pH for SO_2 removal. At periodic intervals, sludge from the reservoir will be piped to the sludge pond for disposal. Make-up water for the absorption system will be provided by pond return water. BACT review of this proposed SO_2 control system was conducted and the system approved by the TACB on 13 February 1980.

Lignite dust will be produced primarily at major points of lignite transfer including rail car unloading ramps, stackout tower(s), the crusher house, and at all lignite conveyor belt systems. Fugitive emissions of lignite dust from lignite handling will be controlled by dust collection, dust suppression and wind barrier systems located at all lignite transfer and unloading points throughout the system. Negative pressure will be employed to remove lignite dust through exhaust ductwork to dust collectors. The dust collected will be returned to the lignite system. Dust collectors will be of the wet dynamic type or combustion dry cyclone-wet dynamic type as required for a particular point of application based on the dust loading. Dust suppression systems also will be provided at the lignite receiving hoppers, active storage tripper conveyor discharges and crusher discharge points. Water will be sprayed on the lignite as it is being transferred through the system. Covers over outdoor conveyors and over the active lignite storage pile will minimize windblown lignite dust.

The proposed emission control systems described above will meet all applicable State and Federal air quality standards. The anticipated maximum rates of controlled emissions from the proposed TOSES are listed in Table 5-7.

5.3.1.3 TOSES Circulating Water System

The circulating water system to be used in conjunction with the proposed TOSES will involve withdrawing water from the proposed cooling reservoir, using the water in the power plant for cooling purposes, and then discharging the condensate back to the cooling reservoir. The bay of the TOSES intake structure will contain six circulating water pumps which will pull water from the Twin Oak Reservoir into the circulating water system. Each pump will have a capacity of 170,000 gpm for a total pumping capacity of 1,020,000 gpm. Water will be pumped from the intake through 132-inch diameter pipelines to the condenser, then discharged to the opposite side of the baffle dike into a "hot pond." The water then will be discharged from the hot pond through a one-mile long canal back to the lake where heat will be dissipated to the atmosphere by conduction, radiation, and evaporation. Figure 5-5 illustrates the location and relationship of the intake structure, hot pond, and discharge canal to the TOSES plant island and proposed Twin Oak Reservoir.

The original design of the TOSES's intake structure was modified after consultation with the EPA to reflect the "best available technology" requirement of Section 316(b) of the Clean Water Act. The entire structure was moved to the lake shoreline in order to eliminate an intake canal. Although the structure is designed to reduce fish impingement, a system is incorporated which returns fish to the reservoir. With the current design, water from the Twin Oak Reservoir will enter the intake at a velocity of 0.20 to 0.35 feet per second (fps), depending on the water level of the reservoir. As water enters the intake, it will pass through a trash/log rack, traveling water screens, a chlorination system, and fine screens before entering the plant.

Table 5-7. Maximum controlled emissions anticipated from the proposed TOSES with both units operating.

Parameter	Maximum Rate of Emission (lbs/hr)
SO_2	17,058
NO_x	9,504
TSP	1,586
Fugitive Dust	BACT*

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*In compliance with Best Available Control Technology.

Source: Adapted from Texas Utilities Services Inc. 1980. Environmental information doucment for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas, Texas, variously paged.

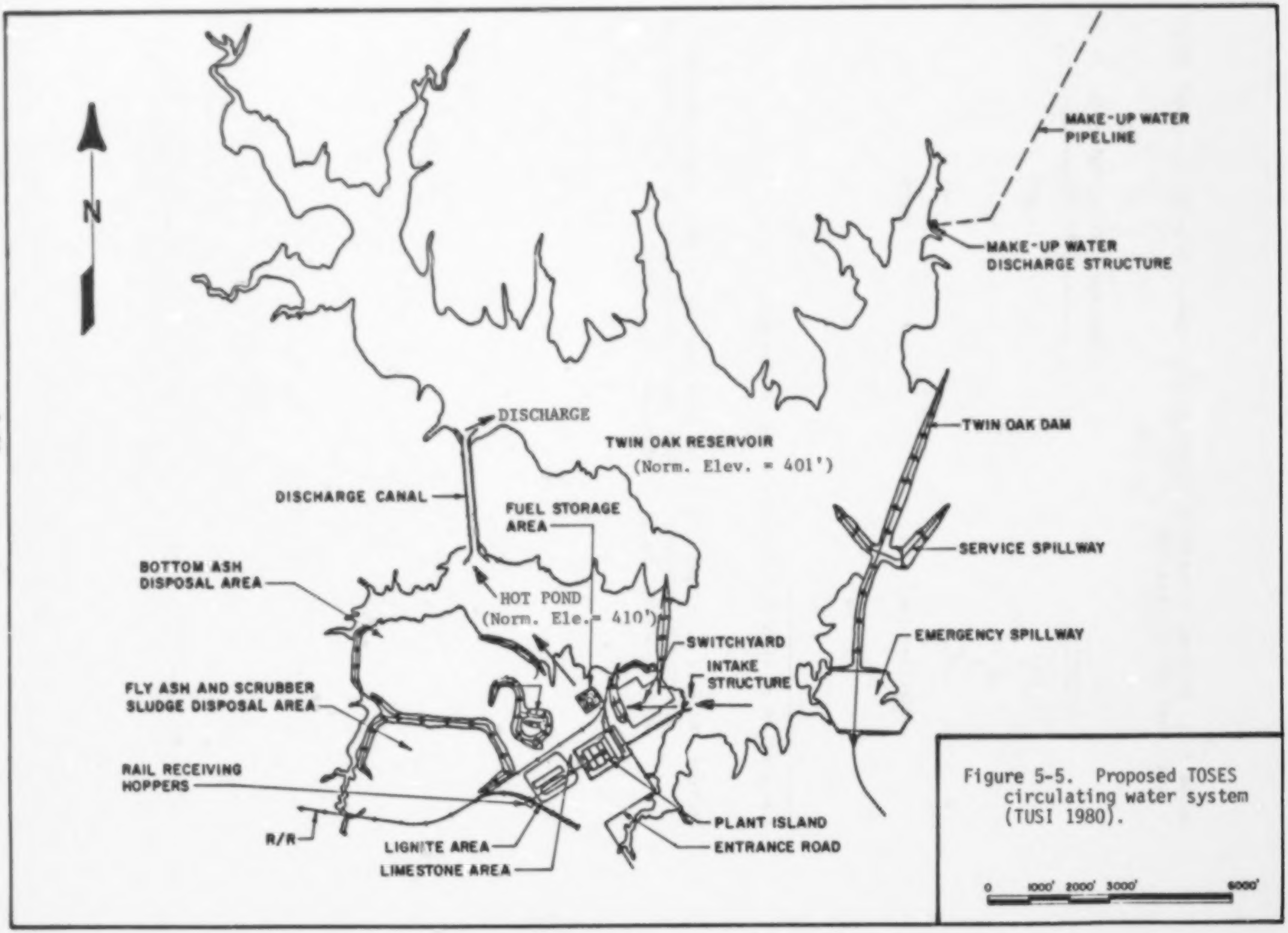
N
MAKE-UP WATER PIPELINE
MAKE-UP WATER DISCHARGE STRUCTURE
DISCHARGE
TWIN OAK RESERVOIR
(Norm. Elev. = 401')
TWIN OAK DAM
DISCHARGE CANAL
FUEL STORAGE AREA
SERVICE SPILLWAY
BOTTOM ASH DISPOSAL AREA
HOT POND
(Norm. Ele. = 410')
SWITCHYARD
EMERGENCY SPILLWAY
INTAKE STRUCTURE
FLY ASH AND SCRUBBER SLUDGE DISPOSAL AREA
RAIL RECEIVING HOPPERS
PLANT ISLAND
R/R
LIGNITE AREA
ENTRANCE ROAD
LIMESTONE AREA
0
1000'
2000'
3000'
6000'

Figure 5-5. Proposed TOSES circulating water system (TUSI 1980).

Chlorine will be injected into the incoming water after it passes the traveling water screens. Chlorine dosage will be regulated to achieve a free available or total concentration of 0.5 ppm at the condenser box inlet. This concentration should eliminate "biofouling" of condenser tubes and minimize chlorine residual in the circulating water discharge. Plans for initial chlorination will be according to the following seasonal schedule:

Winter	1 time/day when ambient temperature is 32°F or greater
Spring and Fall	2 times/day
Summer	3 times/day

After sustained plant operations begin, chlorination schedules will be adjusted to reflect operating experience at the station. The objective of chlorination will be to provide required protection to the condensers while reducing chlorine use to minimum essential levels.

Current effluent limitations of 40 CFR 423.15 require that discharges of free available chlorine from "new source" SES's not exceed 0.5 mg/l maximum nor 0.2 mg/l average. The chlorination system designed for use at the proposed TOSES has been designed to meet these limitations.

5.3.1.4 TOSES Miscellaneous Water Systems

In addition to water for the circulating water system, the cooling reservoir also will provide water required for boiler make-up, fire protection and service uses. Water for these systems will be pumped by separate pumps in the intake structure and chlorinated where required. Make-up feedwater for the boiler will be demineralized and stored. Fire water pumps will provide water to the plant fire protection system through underground fire drops with hydrants, fire hose stations, deluge spray systems, and sprinkler systems.

5.3.1.5 TOSES Water Pollution Control Systems

Wastewaters requiring treatment prior to discharge will be generated by the circulating water system and miscellaneous water systems previously described. Other sources of wastewater discharges from the proposed TOSES facility include water from fly and bottom ash handling systems, effluents from the SO_2 scrubber system, water treatment wastes, secondary treated domestic sewage effluent, station cleaning wastes, and rainfall runoff from plant, rail spur, and lignite storage areas. Contaminated rain water (i.e., rainfall runoff) at the TOSES potentially will include runoff from a 750 x 1,000 foot area inside the plant loop road (Figure 5-4). In this area, small quantities of fly ash, scrubber sludge, and lignite dust potentially can contaminate rainwater. Other areas likely to contaminate rainfall runoff are the 1,500 x 1,000 foot lignite storage area and the 3-acre limestone storage area. Transport and handling of lignite, fuel oil, and limestone over the plant's rail spur also creates an area which can potentially contaminate rainfall. A proposed 28-acre switchyard also could contribute small quantities of oil and/or suspended solids to rainfall runoff.

Wastewaters generated by these various sources will be collected, treated, and discharged via eight (8) discharge pipes (i.e., outfalls) in the vicinity of the proposed TOSES plant island. Table 5-8 lists the eight outfalls, the wastewaters contributing flow to the outfall, and the treatment systems to be utilized to treat the wastewaters prior to discharge at each outfall. Figure 5-6 illustrates the location of each of the eight proposed outfalls. A brief description of these wastewater treatment systems is presented in the following paragraphs:

- Cooling Water. Water from the Twin Oak Reservoir will be passed through condensers to cool exhaust steam to condensate. The cooling water will be warmed in the process and returned to the Twin Oak Reservoir through a discharge canal system. The intake water will be shock chlorinated at a maximum interval of two hours per unit per day to prevent biofouling in the system. Residual chlorine remaining in the water will be dissipated to permitted levels prior to discharge at Outfall 001.

- Lignite Storage Area Runoff. Rainfall runoff from the lignite storage areas will be collected in a pond for settling of solids. Polyelectrolyte will be added when needed to enhance solids settling. Standard

Table 5-8. Wastewaters to be collected, treated, and discharged via eight outfalls at the proposed TOSES.

Outfall No.	Wastewater Source	Treatment To Be Provided
001	Condenser non-contact cooling water (1,470 mgd).	Shock chlorination; non-contact cooling; discharge.
002	Lignite storage/limestone storage area rainfall runoff (variable flow).	Solids settling; neutralization as required; recycle or discharge.
003	Sanitary sewage and other wastewater from potable water usage (14,800 gpd).	Extended aeration; activated sludge; solids settling; chlorination; discharge.
004	Fuel oil unloading and storage area rainfall runoff (variable flow).	Solids settling; oil-water separation; discharge.
005	Low volume wastewater, including equipment washdown, equipment drains, turbine bldg. drainage, dust control (variable flow).	Solids settling; evaporation; oil-water separation; discharge.
006	Bottom ash sluicing; equipment cleaning, demineralizer wastes, condensate polisher, FGD washdown, boiler area rainfall runoff (variable flow).	Solids settling; evaporation; metal ion reduction; discharge or recycle.
007	Fly ash and FGD system waste water, rainfall runoff from FGD and ESP pipe areas (variable flow).	Solids settling; metal ion reduction; discharge or recycle.
008	Railroad area rainfall runoff (variable flow).	Solids settling; discharge.

Source: Adapted from Texas Utilities Services Inc. 1980. Appendices to environmental information document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas, Texas, variously paged.

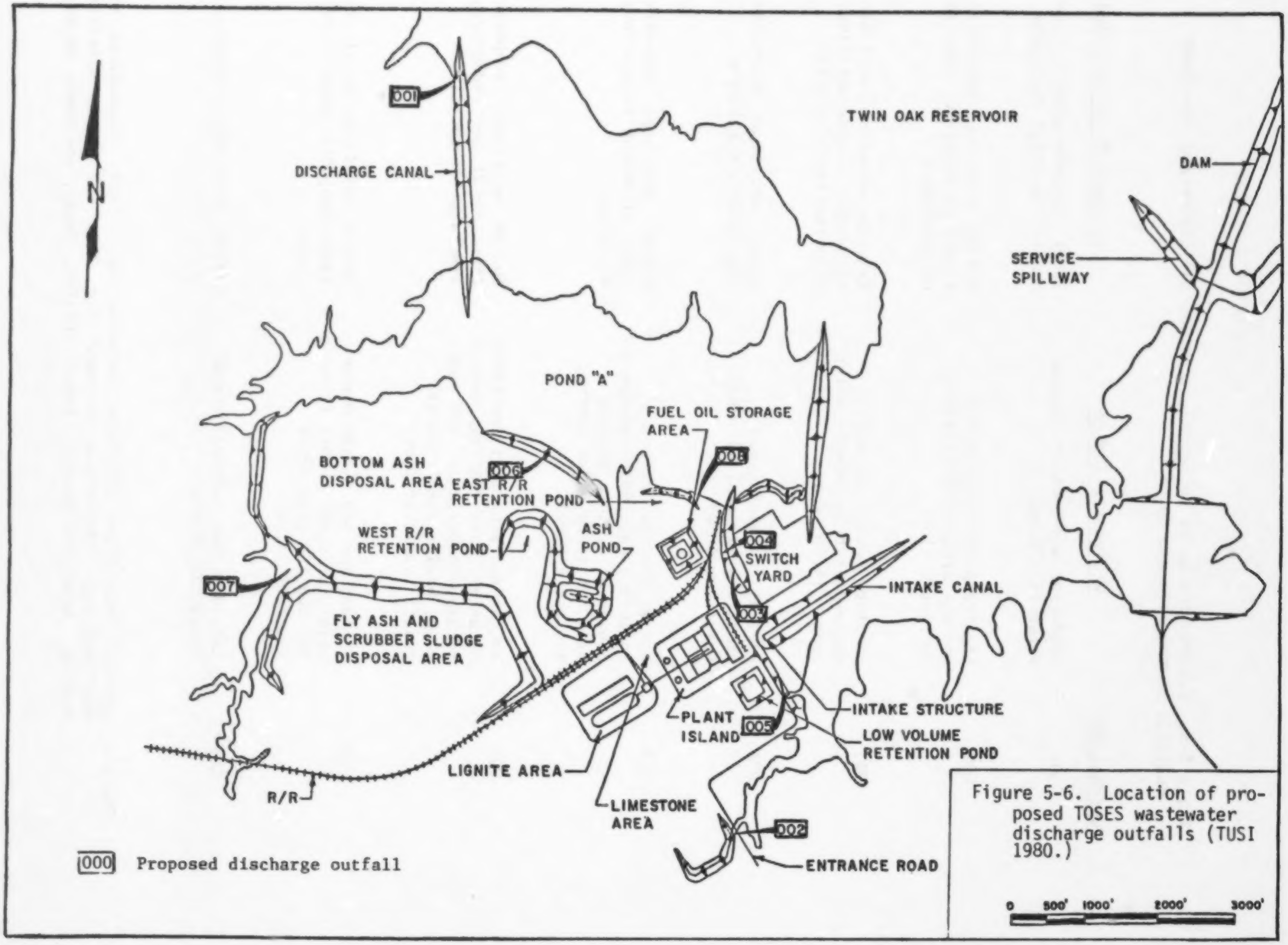
TWIN OAK RESERVOIR
N
DISCHARGE CANAL
001
DAM
SERVICE SPILLWAY
POND "A"
FUEL OIL STORAGE AREA
008
BOTTOM ASH DISPOSAL AREA
006
EAST R/R RETENTION POND
WEST R/R RETENTION POND
ASH POND
004
SWITCH YARD
INTAKE CANAL
007
003
FLY ASH AND SCRUBBER SLUDGE DISPOSAL AREA
PLANT ISLAND
005
INTAKE STRUCTURE
LOW VOLUME RETENTION POND
LIGNITE AREA
LIMESTONE AREA
R/R
002
ENTRANCE ROAD
000 Proposed discharge outfall
0
500'
1000'
2000'
3000'

Figure 5-6. Location of proposed TOSES wastewater discharge outfalls (TUSI 1980.)

practice will be to maintain the pond level below the discharge point by reusing the water as ash pond system make-up water, or for plant recycle water. Excess treated runoff will be discharged through Outfall 002.

- Sanitary Sewage Treatment. Raw wastewater will be passed through a trash screen or comminutor before entering the aeration basin to be mixed with activated sludge and provided air for bacteria support. From aeration, the mixed liquor will flow to a clarifier. Clarifier effluent will flow to a chlorine contact chamber for disinfection. Chlorine will be supplied as hypochlorite solution or solid. From the chlorine contact chamber wastewater will be discharged to the lake via Outfall 003.

- Oil Storage Area Rainfall Runoff. The oil storage area will be diked on all sides. Rainfall water trapped within the dike will be treated for settling of suspended solids and passed through a water-oil separator. Discharge will be made at Outfall 004 into the cooling water channel and from there into the hot pond of the Twin Oak Reservoir.

- Low Volume Wastewater. Low volume wastewater will be treated in gravity flotation units. Wastewater flow then will be equalized in a retention pond which also will provide for removal of suspended solids by gravity sedimentation. Wastewater contained in the low volume waste retention pond will be reused as ash or FGD system make-up when possible. When wastewater is in excess of practical reuse capabilities, it will be discharged within permit limits via Outfall 005.

- Bottom Ash Discharge Water. Bottom ash will be sluiced to ash ponds, where the ash will settle and the sluice water will be continuously recycled to the ash hoppers. Low volume wastes, equipment wash, demineralizer blowdown, condensate polisher effluent and boiler area rainfall runoff will be routed to the ash ponds for make-up to the ash sluicing system. Blowdown or discharge from the ash pond will be used for make-up to the Flue Gas Desulfurization (FGD) system when practical. Discharge of treated blowdown from the bottom ash system will occur via Outfall 006.

- Fly Ash and FGD System Wastewater Discharge. Facilities to treat accumulated FGD system and fly ash wastewaters will be designed, installed, and operated to comply with EPA effluent guidelines. Recycle and reuse of these wastewaters will be made as practical in the FGD system and fly ash system make-up. Use of product water and disposal of wastewaters from the treatment system are included in the design evaluation. Excess treated FGD system wastewaters will be discharged through Outfall 007.

- Railroad Area Water Runoff. Storm water runoff from the east railroad area will flow to the east railroad area retention pond for settling of suspended solids. Discharge will be made from the settling pond to Twin Oak Reservoir at Outfall 008. Rainfall on the west railroad area will flow to a west railroad retention pond for settling of fines. Water from the west pond will be recycled for inplant reuse. Any overflow from the west railroad retention pond will flow to the bottom ash disposal area for recycle and/or discharge via Outfall 006.

The goal of the liquid wastewater treatment systems at the proposed TOSES will be zero discharge of fly ash, bottom ash, and scrubber sludge wastewaters. These wastewaters will be recycled to the maximum extent possible. Wastewaters discharged from the eight proposed outfalls will comply with effluent limitations established for new source steam electric generating stations. EPA's draft NPDES permit (Appendix C) contains effluent limitations for each of the eight proposed outfalls. A State Waste Control Ordinance (WCO) permit (Permit #01986) was issued effective 10 February 1982.

Design of retention and settling ponds will incorporate special features to prevent groundwater and surface water pollution. Retention/settling ponds will be designed to accommodate a 10-year, 24-hour storm event, and lined with impervious clay (maximum permeability equal or less than 1.0×10^{-7} cm/sec.). Areas designed for permanent disposal of fly ash, bottom ash, and scrubber sludge will be lined with impervious clay and sized to hold a 25-year, 24-hour storm event. A series of ditches and dikes will divert uncontaminated rainfall runoff away from the ponds and into the Twin Oak Reservoir. There will be no untreated discharges from the ponds or disposal areas.

5.3.1.6 TOSES Solid Waste Disposal System

Primary sources of solid wastes from the proposed TOSES will be the boilers, electrostatic precipitators (ESP's), and the FGD system. When the 1,500 MW station is in operation it will generate approximately 126,000 tons of boiler bottom ash, 505,000 tons of fly ash, and 210,000 tons of FGD sludge per year. These types of industrial wastes are typically categorized as Class I wastes by the Texas Department of Water Resources (TDWR). In August 1980, the TDWR was requested to reclassify such wastes to a Class II or III category. This request was approved on 11 July 1981. These wastes are therefore exempt from the hazardous waste provisions of the Resource Conservation and Recovery Act (RCRA).

Solid waste disposal facilities at the proposed TOSES will consist of landfills. Disposal of the TOSES ash and FGD sludge will conform to EPA and TDWR technical guidelines for design, construction, and operation of landfill waste disposal facilities. Fly ash and scrubber sludge will initially be deposited in a 120-acre landfill located approximately 0.5 miles west of the plant site (Figure 5-5). Storage capacity of this facility should be adequate for wastes generated for about 6 years. Plans for disposal of fly ash and FGD sludge for remaining years of the 35-year planning period have currently not been described by the permit applicant. Dried fly ash and bottom ash potentially will be offered for sale as admixture for concrete or road paving material, since markets for the ash do exist (by phone, Bob Howard, Chemical Waste Management, Inc., Houston, Texas, 10 November 1980). If the ash wastes were to be marketed, the life of the proposed landfill facility could be lengthened considerably. If the proposed landfill is utilized to capacity, and the ash not marketed, another landfill of similar design would need to be constructed on-site (i.e., within 50 miles of the TOSES plant island).

Adjacent to and north of the fly ash and scrubber sludge landfill facility will be another site of similar size which will receive boiler bottom ash. Waste storage capacity will permit storage of bottom ash wastes over the expected life of the plant (approximately 35 years). Wastes will be deposited to an average depth of 30 feet in a progressively east to west application.

Landfill facilities will be lined with synthetic liners or natural clays to reduce permeabilities to the TDWR requirement of 1×10^{-7} cm/sec to prevent contamination of groundwater. The permit applicant has also stated that other landfill criteria and monitoring will be incorporated as required by good engineering practice; however details of proposed monitoring systems have not been described. Landfill disposal facilities will be designed to contain the 24-hour/25-year flood event in accordance with current TDWR criteria.

Transportation of the TOSES solid wastes from plant sources to landfill disposal sites probably will be by hydraulic pumping of slurried wastes because of the comparatively short distance between the plant and the disposal areas. Recycled water from plant processes will be used for the slurry systems. Return water pump stations at low elevations within the facilities will collect and return impounded slurry water for closed cycle plant reuse. There will be no untreated discharge of liquid effluents from the landfill disposal sites.

5.3.1.7 Hazardous Wastes Management System

Texas Utilities Services Inc. has registered both the proposed TOSES and its associated mine with EPA and TDWR as generators of minor quantities of hazardous wastes. However, laboratory analyses of waste streams at TUGCO facilities similar to the proposed TOSES indicate that the high volume waste streams which will be produced by the TOSES will not be hazardous according to EPA criteria. These high volume waste streams will include waters from demineralizer regeneration and chemical cleaning wastes. Both will be segregated into a station sump for treatment designed to render the effluent nonhazardous. This segregation-by-sump system will be registered with TDWR and EPA as a treatment facility.

Small quantities of wastes, including waste oil, and used batteries will be temporarily retained and stored prior to being recycled. Absorbent shop materials will be disposed of in an environmentally acceptable manner.

5.3.1.8 Cooling Reservoir

The Twin Oak dam and cooling reservoir has been constructed on Duck Creek in Robertson County, Texas. Total drainage area above the dam is 45 sq miles. The cooling reservoir will be operated at normal pool elevation 401 ft msl, at which the reservoir will occupy 2,330 acres and contain about 30,300 acre-feet of storage. The minimum allowable water surface elevation for the proposed reservoir will be 395.0 ft msl. At present, only 300 acres are flooded. A baffle dike extending 2,500 feet across the Herds Branch area of the cooling reservoir will be constructed in order to separate the intake and discharge canals. A heat dissipation pond (i.e., hot pond) will be created on the discharge side of the main cooling reservoir body. Water level in the dissipation pond will be maintained at elevation 410 ft msl by a terminal structure and discharge canal. Table 5-9 presents pertinent design and engineering data for the dam and cooling reservoir.

The Twin Oak Dam embankment was constructed of compacted earth, is about 7,700 feet long, including service spillway, and has a maximum height of approximately 56 feet. The top of the embankment will be at elevation 414.0 ft msl,

Table 5-9. Pertinent design and engineering data for the proposed Twin Oak Dam and Reservoir.

Drainage Area: Twin Oak Dam Site: 45 square miles

Estimated Annual Runoff at Dam Site:	Acre-Feet	Inches
Maximum (1957)	34,681	14.4
Minimum (1963)	459	2.7
Average (30 years)	13,789	5.75

Spillway Design Flood:	
Duration of storm	48 hours (hr)
Total depth of rainfall	21.20 inches (in)
Initial rainfall loss	1.00 in
Average infiltration rate	0.05 in/hr
Total depth of rainfall excess	18.50 in
Total volume of inflow to full reservoir	18.71 in
Total volume of inflow to full reservoir	44,900 acre-feet
Peak inflow to full reservoir	43,800 cubic feet per second (cfs)
Maximum outflow:	
Service Spillway	21,800 cfs
Emergency Spillway	0 cfs

Test Flood:	
Duration of storm	48 hr
Total depth of rainfall	39.75 in
Initial rainfall loss	1.00 in
Average infiltration rate	0.05 in/hr
Total depth of rainfall excess	36.75 in
Total volume of inflow to full reservoir	37.00 in
Total volume of inflow to full reservoir	88,800 acre-feet
Peak inflow to full reservoir	63,500 cfs
Maximum outflow:	
Service Spillway	27,800 cfs
Emergency Spillway	21,000 cfs

Service Spillway:	
Length at crest (net)	80 ft
Crest elevation (ft msl)	389.0
Type	Controlled Ogee
Control	Two - 40' x 14' Tainter Gates
Top of gates (elevation, ft msl)	403.0

Table 5-9. Pertinent design and engineering data for the proposed Twin Oak Dam and Reservoir (concluded).

Emergency Spillway:

Type	Unpaved, Broadcrested
Length	1,500 ft
Control elevation (ft msl)	407.0

Low-Flow Outlet:

Purpose	Diversion during construction and reservoir regulation
Size	30-in diameter
Location	Base of spillway pier
Control elevation	380.0 ft msl
Capacity	115 cfs with reservoir at elevation 401.0

Reservoir:

Feature	Elevation (ft msl)	Surface* Area (acres)	Total Capacity (acre-feet)
Top of Dam	414.0	4,000	70,885
Maximum W.S. Test Flood	410.0	3,420	56,045
Emergency Spillway Crest	407.0	3,040	46,347
Maximum W.S. Design Flood	406.8	3,014	45,752
Normal Pool	401.0	2,330	30,319
Service Spillway Crest	389.0	1,130	9,833
Streambed	358.0	0	0

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*Area-capacity data reflects initial reservoir conditions.

Source: Adapted from Texas Utilities Services Inc. 1980. Environmental information document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas, TX, variously paged.

with a top width of about 20 feet. A service road with a six-inch compacted gravel surface will be provided on top of the dam. The embankment will provide a 7.2-foot freeboard above the maximum design flood elevation. The upstream and downstream side slopes will be 3:1 (three horizontal to one vertical). Riprap will be placed on the upstream slope from elevation 285.0 to 414.0. An impervious core is planned for the central portion of the embankment.

The service spillway (located in the right abutment) will be a concrete gravity structure with an average crest at elevation 389.0 and the top of the tainter gates at elevation 403.0. The maximum discharge for the design water surface elevation (i.e., 406.8 ft msl) is 21,800 cfs. A 30-inch diameter sluice will be constructed through the center pier to be used for diversion during construction, and later for reservoir regulation. A conventional stilling basin, with baffles and end sill will be provided. An emergency spillway will also be located in the right abutment. It will be a 1,500-foot wide open channel at control elevation 407.0 ft msl. Approach and discharge areas will be excavated to a plane surface and graded to drain in each direction. The emergency spillway will not be required during passage of floods equal to or less than the spillway design flood.

To insure proper operation of the proposed reservoirs, computer modeling was performed for the period of record 1941-1970. Computer modeling determined how the proposed reservoir theoretically would have functioned if it had been in place and operating during the "wet years" and "droughts" that occurred from 1941-1970. Modeling determined that, with sufficient makeup water from Lake Limestone, Twin Oak Reservoir will supply the required 13,200 acre-feet of water per year for consumptive use by the proposed TOSES without falling below the minimum level of 395.0 ft msl. Make-up water from Lake Limestone will average approximately 7,000 acre-feet per year, and potentially will not exceed approximately 22,000 acre-feet during any one year. In addition to satisfying consumptive use at the TOSES, adequate water will be available to honor downstream water rights (approximately 96 acre-feet per year) and to sustain an average spill (discharge) of approximately 3,400 acre-feet per year into Duck Creek. Although modeling has shown that up to 19 years of the 30 year period of record show no flow in Duck Creek, TUGCO is required by TWRC permit to maintain a flow of at least 15 acre feet per month.

Water discharged into the reservoir from the proposed TOSES circulating water system (see Section 5.3.1.3) will contain heat from the process of steam condensation. Computer modeling of thermal conditions within the reservoir was performed to predict the reservoir response to the receipt of thermal discharges under "worst case" conditions. Worst case conditions for the period of record (1941-1970) were assumed to be similar to the drought conditions of August 1963, i.e.:

- Water surface elevation of Twin Oak reservoir at 396.0 ft msl (one foot above minimum level), with a corresponding reservoir capacity of 19,000 acre-feet;
- Air temperature of 100°F or greater for 10 of 30 days;
- Plant operating at 100% capacity day and night for 30 days prior to the hottest day;
- Make up water, at a temperature of 65°F, obtained from Lake Limestone at a rate of 73 acre-feet per day; and
- No natural runoff to reservoir (i.e., no rainfall) due to drought conditions.

For reservoir operation as proposed by the permit applicant, model predictions indicate that, under August 1963 drought conditions, water in the reservoir will be recycled every 4.5 days. Maximum discharge temperature at the point where circulating water is returned to Twin Oak Reservoir is predicted to be 103°F. On the day with highest water temperature (equivalent to 8 August 1963), 68.3% of the lake surface should be at or below 95°F.

The permit applicant's EID states 68.3% of the lake surface should be at or below 95°F under the proposed thermal discharge conditions of 103°F daily average and 110°F daily maximum. The NPDES permit for the proposed TOSES project (if issued) limit thermal discharges to these conditions.

5.3.1.9 TOSES Schedules and Personnel Requirements

Unit 1 and Unit 2 of the proposed TOSES will be built in accordance with the following phased construction schedule:

	Unit 1	Unit 2
Begin Trial Operation:	August 1987	August 1989
Begin Commercial Operation:	February 1988	February 1990

Construction activities at the power plant site will continue through 1990, and will require a maximum of 1,000 construction workers during 1987 (see Table 5-10). Additional workers involved with mine construction and operation of previously installed power plant equipment also will be actively engaged during the peak construction period. Operation of the TOSES will require approximately 350 full time workers. It is anticipated by TUSI that most of the construction and operation personnel will be hired from outside of the project area and will relocate within 50 miles of the project site.

The estimated total cost of the proposed TOSES (including the associated transport facilities) and the proposed Twin Oak Mine is:

TOSES	$1,432,728,000
Mine	775,833,000
TOTAL PROJECT	$2,208,561,000

5.3.2 Transport Systems

The proposed TOSES involves other systems in addition to those that will be built directly at the plant island (i.e., plant site). These additional facilities, called transport systems, include the proposed transmission lines, a make-up water pipeline, and a railroad spur. A description of each of these transport systems, which extend beyond the confines of the proposed TOSES project site, is presented in the following sections.

5.3.2.1 Transmission Lines

Transmission line facilities planned for the proposed TOSES project consist of six line segments. One segment will contain one 138 KV line; four segments

Table 5-10. Personnel requirements for construction and operation of the proposed TOSES, associated transport facilities, and the associated Twin Oak Mine.

	Power Plant Requirements			Mine Requirements		
Year	Construction Personnel	Operation Personnel	Total	Construction Personnel	Operation Personnel	Total
1982						
1983						
1984	350		350	75		75
1985	600	13	613	150	5	155
1986	1,000	81	1,081	100	34	134
1987	1,000	234	1,234	150	235	385
1988	600	312	912	150	415	565
1989	500	353	853	100	464	564
1990	200	353	553	50	596	646
1991					596	596
1992					628	628
1993					734	734
1994					936	936
1995					971	971
1996–2018					971	971

Source: Adapted from Texas Utilities Services Inc. 1980. Environmental information document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas TX, variously paged.

contain one 345 KV line; and one segment will contain one 138 KV line and one 345 KV line. The location of each of these proposed lines is illustrated by line segments 1 through 6 in Figure 5-2 (segments 5A and 6A were alternative alignments not selected for utilization). Construction of proposed lines will involve new rights-of-way in some areas, and use of existing rights-of-way in other areas. A total of about 3,089 acres of land will be utilized for transmission corridors. Approximately 1,502 acres of new right-of-way will be required to construct the proposed lines, while approximately 1,587 acres of existing right-of-way will be utilized (see Table 5-11).

Four basic tower structure types will be utilized on the proposed TOSES project. All structures will be designed to meet current requirements of the National Electric Safety Code (NESC) Heavy Loading District Criteria. Two basic structure types will be used for new 138 KV lines on the TOSES project. The first type of structure is diagrammed in Figure 5-7. This type structure currently is in use on an existing Lake Creek-Jewett 138 KV line and will be used on the tap line segment to the proposed Limestone pump station (Segment 1).

The second type of structure (Figure 5-8) is a latticed steel tower designed to carry two 138 KV circuits. The base of the tower is rectangular, approximately 13 x 20 feet, with an 85-foot tower. This structure will be used on the 17-mile line segment from the Twin Oak Junction to the proposed TOSES (Segment 5).

Two basic structure types will also be used for new 345 KV lines on the proposed TOSES project. The first structure is diagrammed in Figure 5-9. This latticed steel tower designed to carry two 345 KV circuits, has an average height of 127 feet, and has a rectangular base of approximately 18 feet by 36 feet. This structure currently is used on existing lines from Tradinghouse SES to Lake Creek SES (Segment 3); from Lake Creek SES to Twin Oak Junction (Segment 4); and from Jewett switch station to Twin Oak Junction (Segment 2) with one 345 KV circuit in place. This project will add second 345 circuits to these towers in the above mentioned locations.

Table 5-11. Transmission facilities proposed for utilization in conjunction with the proposed TOSES.

Line Segment[1]	Line Size	Line Length (mi)	ROW Width (ft)	Existing ROW Utilized (ac)	Proposed New ROW Required (ac)
1	138 kv	8.0	100	-	97
2	345 kv	17.0	225	464	-
3	345 kv	9.5	170	196	-
4	345 kv	34.0	225	927	-
5	138/345 kv	17.0	230	-	474
6	345 kv	48.0	160	-	931
			TOTAL ROW:	1,587	1,502

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[1] See Figure 5-2 for segment location.

Source: Adapted from Texas Utilities Services Inc. 1980. Environmental information document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas TX, variously paged.

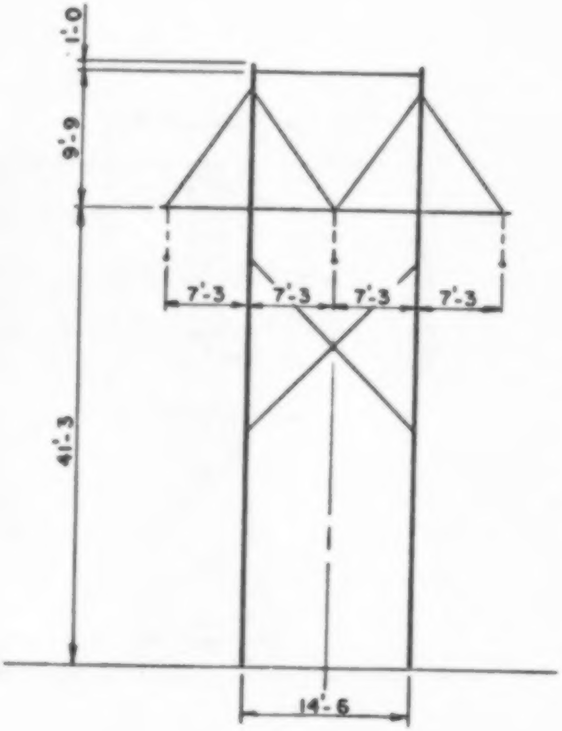

Figure 5-7. 138 KV single circuit wood H-frame proposed for use on TOSES transmission line(s).

Source: Texas Utilities Services, Inc. (1980)
Environmental Information Document for
Twin Oak Steam Electric Station,
Robertxon County, Texas.
Dallas, Texas, variously paged.

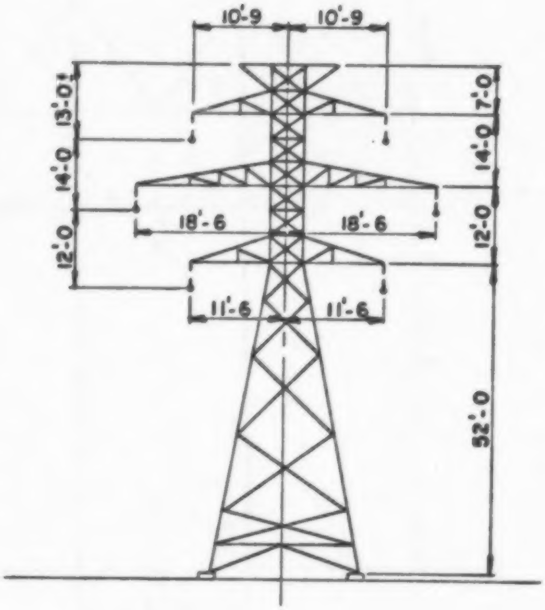
10'-9
10'-9
13'-0
7'-0
14'-0
14'-0
18'-6
18'-6
12'-0
12'-0
11'-6
11'-6
32'-0

Figure 5-8. 138 KV double circuit steel tower proposed for use on TOSES transmission line(s).

Source: Texas Utilities Services, Inc. (1980)
Environmental Information Document for
Twin Oak Steam Electric Station,
Robertson County, Texas.
Dallas, Texas, variously paged.

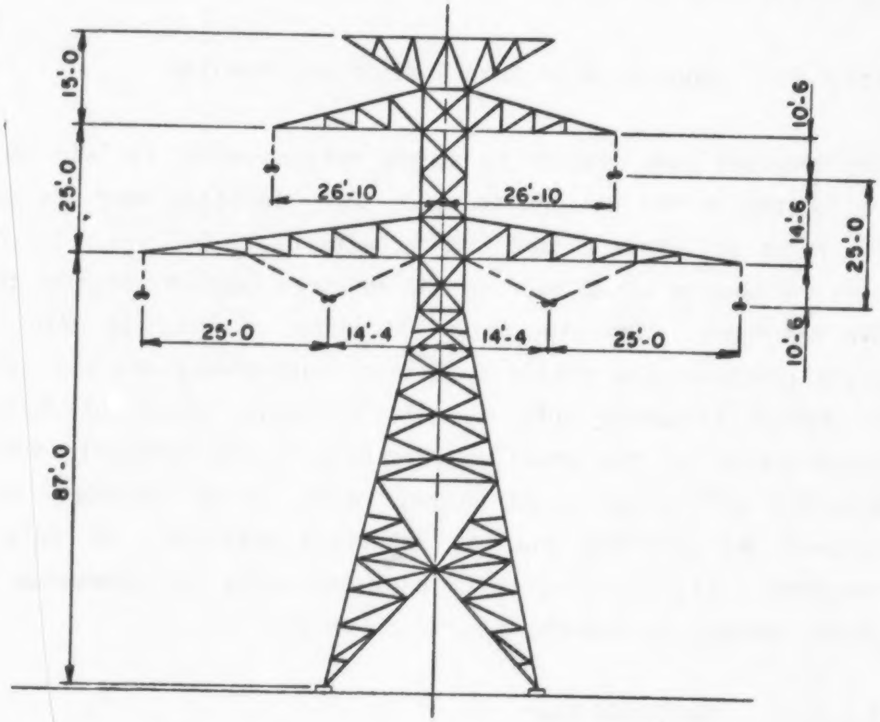
15'-0
25'-0
87'-0
26'-10
26'-10
25'-0
14'-4
14'-4
25'-0
10'-6
14'-6
25'-0
10'-6

Figure 5-9. 345 KV double circuit steel tower proposed for use on TOSES transmission line(s).

Source: Texas Utilities Services, Inc. (1980)
Environmental Information Document for
Twin Oak Steam Electric Station,
Robertson County, Texas.
Dallas, Texas, variously paged.

The second type of structure is diagrammed in Figure 5-10. This latticed steel tower designed to carry two 345 KV circuits, has an average height of 125 feet and a rectangular base of approximately 16 by 33 feet. This structure will be used in two locations on the proposed project; first, on the 17-mile line segment from Twin Oak Junction to the TOSES (Segment 5), and secondly on the 48-mile line segment from the Lake Creek-Temple Loop Line to the TOSES (Segment 6).

5.3.2.2 Make-up Water Pump Station and Pipeline

The proposed pump station to supply make-up water to Twin Oak Reservoir will be located on the western shore of Lake Limestone near the dam (Figure 5-3). Two pumps will have a combined capacity of 22,000 gpm. One of the two pumps will be capable of delivering the required make-up water to the proposed Twin Oak Reservoir. The pipeline will consist of about 12 miles of 42-inch concrete pressure pipe within a 75-foot right-of-way and will discharge through an outlet structure into a small tributary branch of Twin Oak Reservoir. Construction of the pipeline currently is approximately 95% complete. The pipeline will cross eight county roads, three secondary state roads, one natural gas pipeline and one petroleum pipeline. No relocations will be required. All crossings will be constructed in accordance with applicable State, county, or private owners' criteria.

5.3.2.3 Railroad Spur

A railroad spur will be constructed to connect the plant island with existing rail facilities and with new rail facilities which will be built for lignite transport from the Twin Oak Mine to the proposed TOSES plant island. Company owned and operated trains will consist of one 2,500 hp electric locomotive and 20 100-ton bottom dump rail cars. Detailed construction plans for grade crossings, sedimentation control and other railroad spur features have not been completed by the permit applicant.

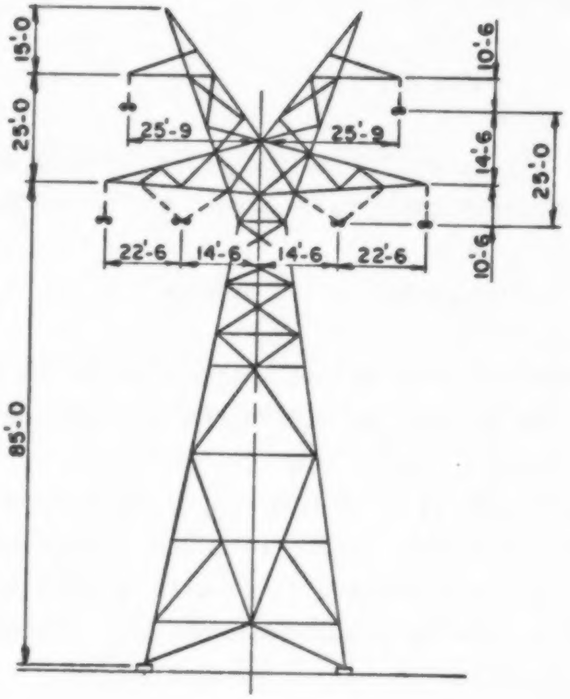
15'-0
25'-0
85'-0
25'-9
25'-9
10'-6
14'-6
25'-0
10'-6
22'-6
14'-6
14'-6
22'-6

Figure 5-10. 345 KV double circuit steel tower proposed for use on TOSES transmission line(s).

Source: Texas Utilities Services, Inc. (1980)
Environmental Information Document for
Twin Oak Steam Electric Station,
Robertson County, Texas.
Dallas, Texas, variously paged.

5.3.3 Mine

Fuel for both units at the TOSES will come from a nearby surface lignite mine (Twin Oak mine) comprised of three deposits, two to the northwest and one to the southwest. Two of the deposits are 8 miles from the plant site, the third is 14 miles from the plant site. Texas Utilities Generating Company (TUGCO) will operate the mine.

5.3.3.1 Lignite Analysis

The TOSES will burn low sulfur Texas lignite from the Twin Oak mine. Ash analyses of the lignite to be burned are presented in Table 5-12.

5.3.3.2 Transportation and Storage

Lignite from the mine will be transported to the plant site by trucks and unit trains. Lignite from the active mine pit will be loaded into 100-ton, bottom-dump diesel haul trucks. Up to 15 trucks will carry lignite over a series of short haul roads to a loading station on a railspur. At the loading station, trucks will transfer lignite to 100-ton, bottom-dump rail cars via a conveyor system. Two unit trains will be used to move up to 38,000 tons per day when the plant is running at maximum capacity. Upon arrival at the plant, each car will dump lignite into an underground hopper. An inclined conveyor will carry lignite from the hopper to the surge silo where it will be distributed to either the active lignite storage pile or the crusher house. A permanent lignite storage pile will be formed using mobile equipment. Active storage will be about 79,000 tons and permanent storage will be about 500,000 to 750,000 tons.

5.3.3.3 Mine Plan

The most recent system expansion study prepared by TUSI planners has estimated commercial operation of Twin Oak Units 1 and 2 by February 1988 and February 1990, respectively. Planning for the Twin Oak mine has been undertaken based on this revised schedule. Major plant design and operating assumptions used for preliminary mine planning are:

Table 5-12. Lignite analysis* for Twin Oak station mine (weight percent).

Proximate Analysis (%)	Average	Range
Moisture	32.8	27.3 - 34.8
Ash	9.4	7.0 - 15.8
Volatile Matter	32.0	30.4 - 34.6
Fixed Carbon	25.8	22.7 - 27.2
Heat Content (BTU/lb)	7,436	6,700 - 7,971
Ultimate Analysis (%)		
Moisture	32.8	27.3 - 34.8
Carbon	42.6	40.3 - 44.8
Hydrogen	3.3	3.1 - 3.5
Nitrogen	0.8	0.6 - 1.0
Chlorine	0.0	0.0 - 0.1
Sulfur	0.9	0.8 - 1.0
Ash	9.4	7.0 - 15.8
Oxygen (Diff.)	10.2	9.5 - 11.5
Ash Analysis (%)		
Silica SiO_2	31.4	27.0 - 38.1
Ferric Oxide, Fe_2O_3	5.6	4.1 - 7.8
Alumina, Al_2O_3	14.2	10.1 - 17.6
Titania, TiO_2	1.1	0.9 - 1.3
Lime, CaO	23.5	14.6 - 40.2
Magnesia, MgO	3.6	2.9 - 4.9
Sulfur Trioxide SO_3	18.8	15.2 - 22.8
Phosphorus Pentoxide P_2O_5	0.2	0.0 - 0.4
Potassium Oxide K_2O	0.2	0.1 - 0.5
Sodium Oxide Na_2O	0.5	0.2 - 0.8
Undetermined	0.9	0.3 - 2.9

*These data represent values from analyses of clean core samples. Mine-run lignite is estimated at 6,5000 BTU/lb.

Source: TUSI. 1980. Environmental information document and appendix for Twin Oak steam electrical station, Robertson County, Texas. Prepared for US Environmental Protection Agency, Dallas TX, variously paged.

Twin Oak Unit 1:	750 MW (Net) Trial Operation -- August 1987 Commercial Operation -- February 1988
Twin Oak Unit 2:	750 MW (Net) Trial Operation -- August 1989 Commercial Operation -- February 1990
Both Units:	Fuel Heat Content -- 6,500 BTU/lb Annual Capacity Factor -- 70% Plant Life -- 35 years Annual Fuel Requirements -- 7.9×10^{6} tons 35-Year Life Fuel Requirements -- 280×10^{6} tons

Twin Oak mine will be comprised of deposits A, B, C, and D (see Figure 5-3). Mining will begin in deposit A and proceed sequentially southward to deposit B, then northward through deposits C and D. Although conceptual mine planning is complete for deposits A and B, refinement and finalization of the plan is lacking. Preliminary planning for deposit C is in progress and planning for deposit D will follow.

As of December 1981, drilling along the western subcrop of deposit A and B is complete. Interior drilling required to accurately define the deposit is currently in progress. Subcrop drilling in deposit C is about 80% complete with remaining subcrop and all interior drilling still required. Neither subcrop nor interior drilling has commenced in deposit D.

Land and lease acquisition is approximately 80% complete in deposits A and B, 70% in deposit D, and 55% in deposit C. Remaining land and leases, including those presently controlled by other interests, are assumed to be available for mining when needed.

5.3.3.4 Mine Schedule

Fuel production required from Twin Oak mine will be 1.5×10^6 tons in 1987, 3.1×10^6 tons in 1988, 4.9×10^6 tons in 1989, 7.0×10^6 tons in 1990, and 7.9×10^6 tons per year for the remaining mine life. Mining will begin in deposit A in 1987 with the first five-year permit area occupying the western quarter of the deposit. Major mine schedule milestones for the first five-year deposit are presented in Table 5-13. Schedules for the remaining deposits are similar but begin at a later date.

5.3.3.5 Mining Method

Twin Oak lignite will be extracted by surface mining techniques which employ a combination of draglines, scrapers, shovels, and backhoes. These methods will permit efficient extraction of up to three seams of lignite at depths of 150 feet or less at an estimated recovery rate of 85%. Surface mining is a dynamic process in which overburden removal, lignite extraction, backfilling, recontouring, and revegetation occur simultaneously along a moving mining front (Figure 5-11). Because these activities occur simultaneously, only about 500 to 750 acres are actually disturbed at one time. A major facilities and equipment schedule is presented in Table 5-14.

Mined lignite will be loaded on 100-ton trucks and transported to rail loading stations. Three loading stations and fuel facilities will be constructed in the mining area. Unit trains owned and operated by TUGCO will transport lignite from the loading stations to the plant.

5.3.3.6 Environmental Control

Surface mining activities in Texas are regulated by the Texas Surface Mining Control and Reclamation Act as administered by the Texas Railroad Commission (TRC). All mining activities conducted by TUGCO in the Twin Oak project area will be in accord with TRC's performance standards for resource extraction, haul road construction, stream diversion, water handling, fugitive dust suppression, and backfilling of mined pits. Similarly, recontouring and revegetation of mined areas will be accomplished within TRC guidelines for soil amendments, species selection, and post-mining land use and productivity.

Table 5-13. Major milestones for the first five-year deposit (Deposit A and B)

TIME	EVENT
October 1, 1979	• Ordered dragline #1
November 1980	• Made final modification dragline #1
	• Started TRRC permit data gathering
September 1981	• Submitted dragline erection site permit to TRRC
November 1981	• Received dragline erection site permit from TRRC
December 1981	• TRRC acceptance of bond on dragline erection site
January 1982	• Complete general mining plan
	• Begin dragline #1 erection site preparation
March 1982	• Receive initial shipment of dragline #1
	• Put dragline #1 in storage
July 1982	• Receive dragline #1 final shipment
January 1983	• Complete detailed 5-year mining plan
October 1983	• Submit completed 5-year TRRC permit application
June 1984	• Order dragline #2
August 1984	• Receive first 5-year TRRC permit approval
September 1984	• Begin Bremond fuel facilities site preparation

Table 5-13. Major milestones for the first five-year deposit (Deposit A & B) (continued).

TIME	EVENT
January 1985	• Begin Bremond fuel facilities construction • Begin railroad spur construction
January 1986	• Begin fuel operations staffing • Begin loading station construction
May 1986	• Complete Bremond fuel facilities • Begin haulroad construction in A Field
June 1986	• Receive initial shipment of dragline #2 • Order dragline #3
January 1987	• Receive dragline #2 final shipment and start erection
March 1987	• Begin haulroad construction in 334 B
April 1987	• Complete dragline #1 • Start mining in A Area with dragline #1 • Complete loading station • Complete railroad • Begin lignite loading • Complete haulroads in B Area
June 1988	• Complete haulroads in 334 South • Complete dragline #2 • Start mining in B Area • Receive dragline #3 initial shipment and start erection

Table 5-13. Major milestones for the first five-year deposit (Deposit A & B) (concluded).

TIME	EVENT
January 1989	• Receive dragline #3 final shipment • Submit second 5-year mining permit to TRRC*
September 1989	• Receive 5-year TRRC permit approval
June 1990	• Complete dragline #3 • Work machine in A Area
March 2001	• Dragline #3 moves to B Area
March 2006	• Dragline #1 moves to D Area
May 2007	• Dragline #2 moves to D Area

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*5-year mining permit will be submitted and received every 5 years throughout the life of the deposit.

Source: 1981a. Preliminary mining plan, Twin Oak lignite surface mine, Robertson and Limestone Counties, Texas. Prepared for US Environmental Protection Agency. Dallas TX, variously paged.

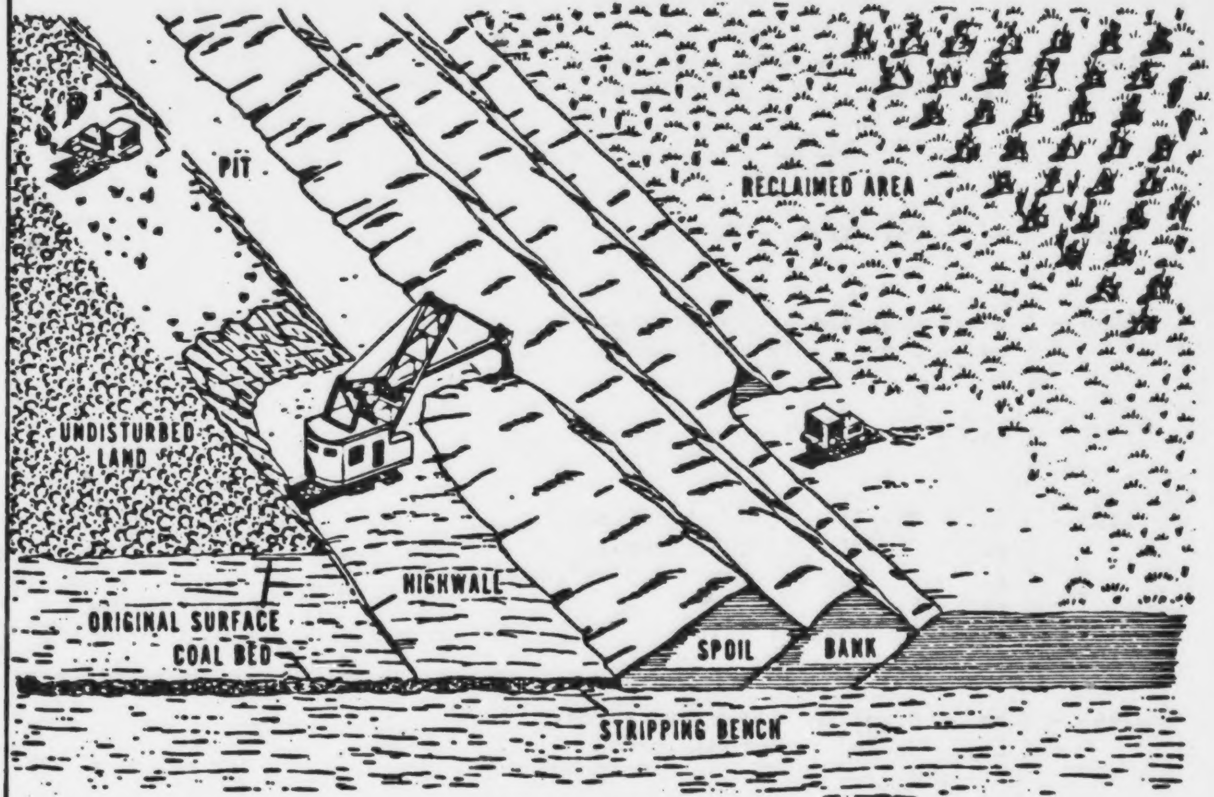

PIT
RECLAIMED AREA
UNDISTURBED LAND
HIGHWALL
ORIGINAL SURFACE
COAL BED
SPOIL
BANK
STRIPPING BENCH

Figure 5-11. Conceptual schematic illustrating proposed surface mining process.

Source: Preliminary mining plan,
Twin Oak lignite surface mine,
Robertson and Limestone Counties, Texas.
Prepared for US Environmental Protection Agency,
Dallas, Texas, variously paged.

Table 5-14. Major equipment and facilities schedule.

1987 - 1 ea. - Dragline - 94 cubic yards
1 ea. - Shovel - 16 cubic yards
1 ea. - Backhoe
1 ea. - Loading Station - 8 mT/yr - Deposit 334
1 ea. - Fuel Facility - A and B Areas
1 ea. - Unit Train - 20 cars
10 ea. - 100T hauler

1988 - 1 ea. - Dragline - 94 cubic yards
1 ea. - Shovel - 16 cubic yards
1 ea. - Backhoe
5 ea. - 100T hauler

1989 - 1 ea. - Unit Train - 20 cars

1990 - 1 ea. - Dragline - 94 cubic yards
1 ea. - Shovel - 16 cubic yards

1992 - 1 ea. - Fuel Facility - C Area

1993 - 1 ea. - Dragline - 94 cubic yards
1 ea. - Shovel - 16 cubic yards
1 ea. - Loading Station - 3.5 mT/yr. - C Area
1 ea. - Backhoe
10 ea. - 100T hauler

1995 - 1 ea. - Dragline - 94 cubic yards
1 ea. - Shovel - 16 cubic yards

2005 - 1 ea. - Fuel facility - D Area

2006 - 1 ea. - Loading Station - 8 mT/yr - D Area

Source: 1981a. Preliminary mining plan, Twin Oak lignite surface mine, Robertson and Limestone Counties, Texas. Prepared for US Environmental Protection Agency. Dallas TX, variously paged.

Surface water runoff from cleared areas, loading stations, and active mine areas will be routed to sedimentation ponds. Collected waters will be treated as required prior to discharge. A series or grid of dewatering wells may precede the active mining front. Groundwater will be treated as required and discharged to undisturbed natural drainages. All aqueous discharges from Twin Oak mine will meet water quality limitations imposed by NPDES, TDWR, and TRC regulations.

Fugitive dust emissions from haul roads and loading stations will be controlled with water. Haul roads will be watered by truck as frequently as necessary to control fugitive dust and maintain safe conditions. Water sprays will be employed at loading stations and at all points of lignite transfer. After lignite is removed, mined pits are backfilled, recontoured, and revegetated in accordance with TRC requirements. Elapsed time between active mining and revegetation is 9 to 12 months depending on weather conditions. Mixed overburden is planned to be used as the planting medium although not yet approved by the TRC. Fertilizer will be applied in amounts dictated by post-mining overburdern analysis. Principal objectives of TUGCO's reclamation operations are prompt revegetation for soil stabilization and return of all mined lands to pre-mining land use and productivity. Specific details of TUGCO's reclamation planning for Twin Oak mine will be presented in the application to TRC for a surface mining permit.

5.3.3.7 Permit Acquisition

Both Federal and State permits are required before Twin Oak mine can be placed in production. An NPDES permit is required by EPA for aqueous discharges from the mining area. EPA's NPDES permit for TUGCO's proposed first 5-year mining area has been issued effective 10 May 1982. This permit must be renewed every five years.

The TDWR requires operators of surface mines in Texas to apply for and receive a Waste Control Permit for mining area discharges. Such a permit was received by TUGCO on 18 April 1975. Permit renewal was granted on 10 February 1982. The Texas Air Control Board (TACB) will receive TUGCO's application for a loading station construction permit in August 1983.

As previously mentioned, the TRC is the primary regulatory authority for surface mining in Texas. A detailed mining and reclamation plan for Twin Oak mine's first five-year permit area will be prepared by TUGCO and submitted to TRC in 1983. Permit renewal applications will be submitted at five-year intervals.

5.4 ALTERNATIVES AVAILABLE TO EPA

EPA's alternatives are either to issue a new source NPDES permit to TUGCO for the proposed TOSES or to deny the NPDES permit. Based on anticipated project impacts, conditional requirements may also be added to the permit if necessary. Impacts relating to permit issuance are detailed in the following chapter and include both beneficial and adverse effects on the area's existing cultural, biological, physical and socioeconomic resources. Should EPA deny the NPDES permit, the project would probably not be completed resulting in an economic loss to the Company and the local communities.

5.5 ALTERNATIVES AVAILABLE TO OTHER PERMITTING AGENCIES

Permitting agencies other than EPA also require certain permits, certifications, or approvals. Table 3-1 (contained in Chapter 3) lists known required major permits for the power plant and the mine, including the corresponding permitting agencies, application dates, and status. Each permitting agency typically has the alternative course of action of either issuing permits, issuing permits with modifications to the proposed project, or denying the permits. With regard to the proposed TOSES, the only permit remaining to be issued is EPA's NPDES permit.

CHAPTER 6.0

ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED PROJECTS

6.0 ENVIRONMENTAL CONSEQUENCES OF THE PROPOSED PROJECTS

Since construction of the TOSES is currently ongoing, some environmental impacts have already taken place. Impacts that have occurred are described under the no action alternative, while impacts resulting from construction completion and operation of the TOSES are discussed in the proposed project consequences section.

6.1 EARTH RESOURCES

6.1.1 Existing Conditions

A description of the existing earth resources is presented to enable a sound understanding of the topography, geology, and soils of the project area. A thorough description of earth resources is necessary to understand the effects of altering (clearing, digging, scraping, etc.) the physical features of the earth's surface during site development.

6.1.1.1 Topography

The project area is in the Gulf Coastal Plain Physiographic Province. The gently rolling hills characteristic of the province are also characteristic of the project area. Elevations in the project area range between approximately 300 and 600 ft msl. Local relief varies by up to 150 feet, with slopes normally less than 5%. The major project area drainage includes the Navasota River which eventually drains into the Brazos River. Additionally, several minor tributaries and ephemeral streams drain into the Navasota River or Brazos River.

The Twin Oak project site occurs in a predominantly level topography at an elevation of approximately 420 ft msl. Slopes on the project site range up to 7%, although slopes of 2 to 3% are typical. The steepest slopes are associated with ephemeral streams which lead into Duck Creek. Duck Creek is the major drainage feature of the project site.

Elevations at the mining sites range from about 310 ft msl to 550 ft msl. Slopes in the mining areas are typically less than 5%. The southern mining area slopes gently to the south and southwest, and drains into Walnut Creek and/or the Brazos River. The northern mining area slopes to the southeast, and drains into the Navasota River by way of Steele Creek.

6.1.1.2 Geology

The project area lies in an extensive area of deep sediments which accumulated due to the erosion of highlands to the northwest. A gradual gulfward subsidence was associated with this deposition of sediments, and accounts for the slight southeasterly dip (normally less than 1%) of the sediments. Through geologic time, the transgression and regression of water from the Gulf of Mexico caused a variety of fluvial, deltaic, and marine environments in the area, thus accounting for the variety and textures of the various sediments (sand, shale, conglomerate, etc.) that were deposited.

Major sedimentary units present in the project area from oldest to most recent are: the Midway Group, Wilcox Group, and Claiborne Group. The Wilcox Group, which is composed of course grained channeled sands with interchannel seams of mud, is the predominant group associated with the proposed project area. Subdivisions (formations) of the Wilcox include the Butler (Hooper), Simsboro, and Calvert Bluff (Figure 6-1).

The Twin Oak project site is situated over the Calvert Bluff Formation as is a portion of the proposed pipeline and transmission corridor. An alluvial deposit lies over the Calvert Bluff Formation along Duck Creek. This deposit will be at least partially covered by Twin Oak Reservoir.

The southern-most mining area primarily occurs within the outcrop area of the Calvert Bluff Formation, and to a lesser extent, the Simsboro Formation. The northern mining area covers parts of all three formations. Alluvial deposits associated with creeks and streams that cross the mining areas will become part of the overburden.

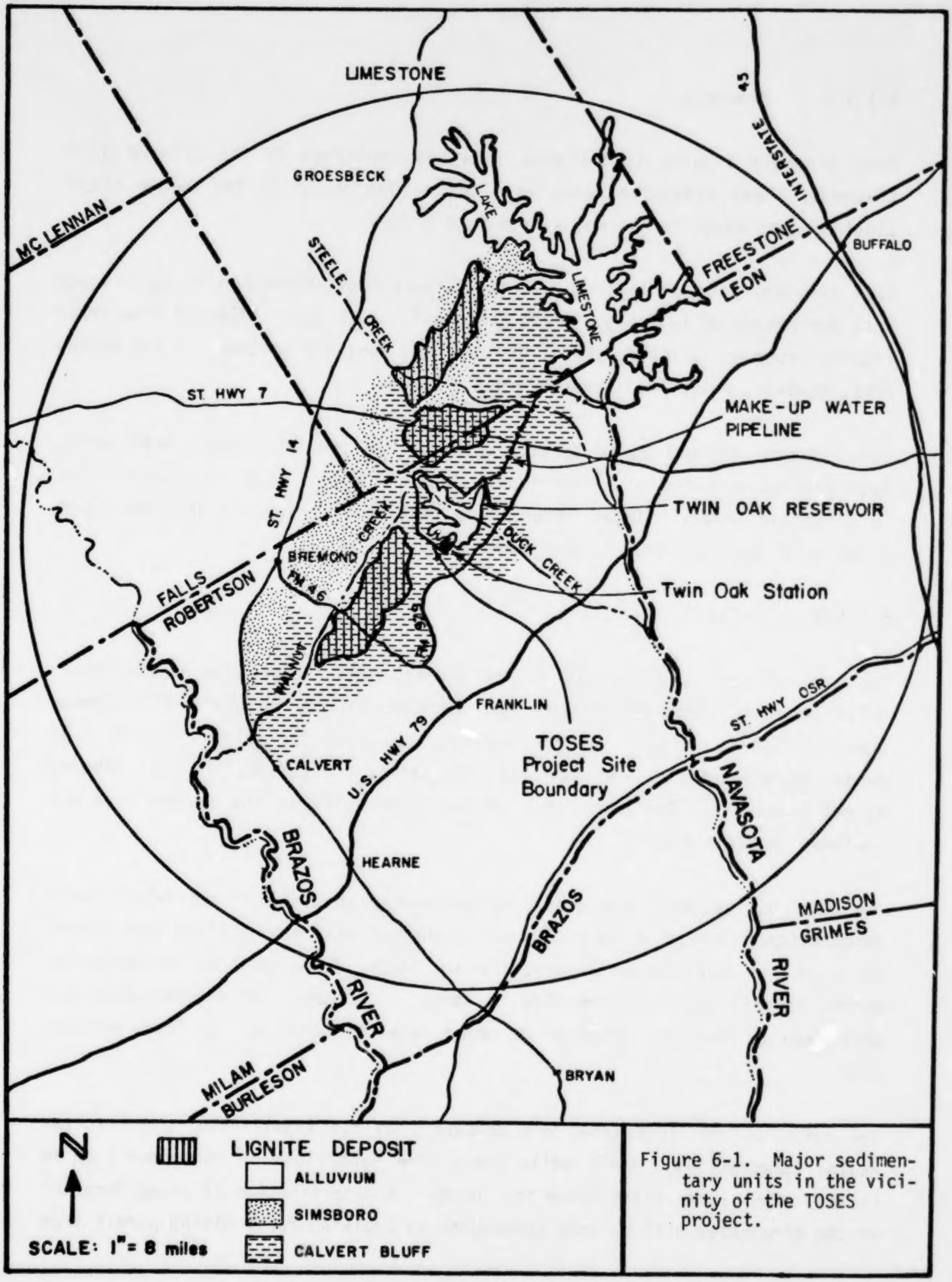

LIMESTONE
GROESBECK
McLENNAN
STEELE CREEK
LAKE
LIMESTONE
FREESTONE
LEON
INTERSTATE 45
BUFFALO
ST. HWY 7
MAKE-UP WATER PIPELINE
ST. HWY 14
TWIN OAK RESERVOIR
CREEK
BREMOND
FM 46
DUCK CREEK
Twin Oak Station
FALLS
ROBERTSON
WALNUT
FM 979
FRANKLIN
TOSES Project Site Boundary
U.S. HWY 79
ST. HWY OSR
CALVERT
NAVASOTA
BRAZOS
HEARNE
BRAZOS
MADISON
GRIMES
RIVER
RIVER
MILAM
BURLESON
BRYAN
N
LIGNITE DEPOSIT
ALLUVIUM
SIMSBORO
CALVERT BLUFF
SCALE: 1" = 8 miles

Figure 6-1. Major sedimentary units in the vicinity of the TOSES project.

6.1.1.3 Minerals

Most mineable lignite in the mine sites is contained in the Calvert Bluff claybeds. Less extensive seams of lignite also occur in the Hooper clays. Lignite seams range in thickness from 1 to 9 feet.

Data from analysis of lignite from the Calvert Bluff Formation in the project area are presented in Table 6-1 and Table 6-2. Data were collected from three lignite reserves in the northern, eastern, and southern sections of the mining area, however, exact locations were not defined.

Other mineral production in the project area is somewhat varied, with petroleum production being most important. Active clay and stone industries occur in Limestone County. Other potentially developable minerals include industrial sand, sand and gravel, and green sand.

6.1.1.4 Soils

The general soil associations in the project area include the Axtell-Tabor, Silstid-Padina, Crockett-Wilson, and Nahatche-Uhland (Figure 6-2). Common characteristics of soils of the project area include: slopes in the 0-5% range, strong acidity, and poor topsoil quality. Site-specific soil mapping is not available. The properties of the major soils in the project area are included in Table 6-3.

The Twin Oak project site occurs predominantly on soils of the Axtell-Tabor Association, although a band of Nahatche-Uhland soil occurs along Duck Creek. Soils of the Axtell-Tabor Association are loamy, while soils of the Nahatche-Uhland Association vary from clay to sandy in texture. No determination has been made by the SCS relative to prime farmland soils on the TOSES project site.

The soils on the mine sites are primarily of the Axtell-Tabor and Silstid-Padina Associations. These soils are a fine sandy loam in the upper 8 to 14 inches, with clayey soils below that depth. A determination of prime farmland on the mine sites will be made subsequent to applying for a mining permit from

Table 6-1. Ash and sulfur content of lignite in the Twin Oak project area (percent by weight).

Deposit	No. of Samples	Ash			Sulfur		
		High	Low	Avg.	High	Low	Avg.
Northern							
As Received	14	13.35	7.60	9.89	1.42	0.73	1.10
Dry	14	19.67	11.65	14.50	2.09	1.08	1.71
Eastern							
As Received	19	15.22	7.23	9.33	1.53	0.65	0.90
Dry	19	21.70	10.24	14.33	2.15	0.99	1.30
Southern							
As Received	9	11.21	6.95	8.75	1.09	0.76	0.92
Dry	9	16.57	10.28	13.17	1.75	1.10	1.39

Source: Southwest Research Institute. 1975. Environmental impact assessment report, Twin Oak and Oak Knoll steam electric power generating facilities, final report. San Antonio TX, variously paged.

Table 6-2. Trace element content of lignite in the Twin Oak project area (parts per million by weight).

Element	No. of Samples	High	Low	Average
Uranium	21	5.70	0.23	1.70
Thorium	21	7.10	0.40	3.12
Bismuth	21	3.10	*	0.49**
Lead	21	4.40	0.72	1.68
Thallium	21	0.75	*	0.15**
Mercury	21	0.41	0.04	0.15
Gold	21	*	*	0.10**
Platinum	21	*	*	0.10**
Iridium	21	*	*	0.10**
Osmium	21	*	*	0.10**
Rhenium	21	*	*	0.10**
Tungsten	21	6.40	*	1.90**
Tantalum	21	6.80	0.09	0.93**
Hafnium	21	2.40	*	0.38**
Lutecium	21	0.36	0.03	0.26
Ytterbium	21	1.20	0.10	0.88
Thulium	21	0.15	0.03	0.12
Erbium	21	1.50	0.06	0.37
Holmium	21	0.65	0.06	0.23**
Dysprosium	21	5.60	0.10	1.41
Terbium	21	0.33	0.03	0.21**
Gadolinium	21	1.00	0.03	0.37
Europium	21	2.00	0.09	0.70
Samarium	21	4.70	0.08	1.74
Neodymium	21	73.00	1.30	12.56
Praseodymium	21	22.00	0.34	3.46
Cerium	21	50.00	6.30	15.07
Lanthanum	21	23.00	0.54	4.64
Barium	21	271.00	9.70	48.32
Cesium	21	0.47	0.01	0.07
Iodine	21	8.40	0.38	2.54

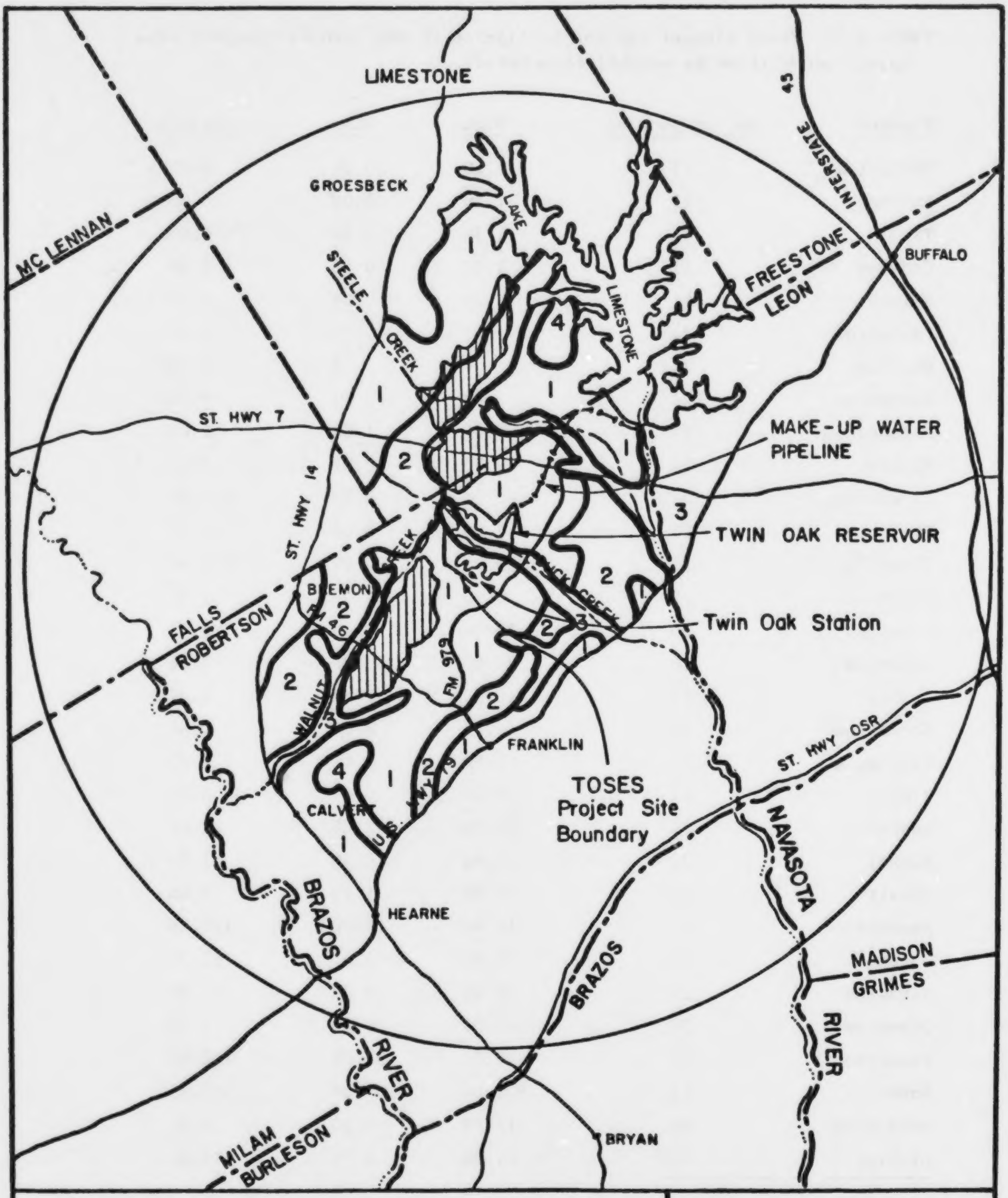
Table 6-2. Trace element content of lignite in the Twin Oak project area (parts per million by weight) (concluded).

Element	No. of Samples	High	Low	Average
Tellurium	21	1.10	0.04	0.17**
Antimony	21	1.20	0.06	0.36**
Tin	21	1.50	0.10	0.65
Cadmium	21	3.70	0.52	1.36
Silver	21	0.38	0.04	0.13**
Palladium	21	*	*	0.10**
Rhodium	21	*	*	0.10**
Ruthenium	21	*	*	0.10**
Molybdenum	21	9.80	1.00	4.64
Niobium	21	9.70	0.97	3.74
Zirconium	21	480.00	8.70	126.32
Yttrium	21	32.00	3.00	12.31
Strontium	21	1200.00	100.00	415.90
Rubidium	20	8.90	0.09	1.48
Bromine	20	29.00	0.45	5.75
Selenium	20	24.00	2.80	7.26
Arsenic	21	10.00	0.67	3.02
Germanium	21	1.30	0.04	0.44
Gallium	21	5.80	0.61	2.25
Zinc	21	110.00	0.40	6.80
Copper	21	80.00	2.40	23.21
Nickel	21	19.00	0.56	5.55
Cobalt	21	13.00	1.10	3.48
Manganese	21	310.00	13.00	170.48
Chromium	21	75.00	3.50	12.31
Vanadium	21	81.00	9.80	31.27
Scandium	21	23.00	1.60	4.59
Fluorine	21	420.00	35.00	132.09
Boron	21	900.00	67.00	377.95
Beryllium	21	11.00	1.30	4.41
Lithium	20	81.00	2.50	19.61

*Less than 0.1 ppm

**One or more samples reported as less than 0.1 ppm; value of 0.1 used in each such case to determine average.

Source: Southwest Research Institute. 1975. Environmental impact assessment report, Twin Oak and Oak Knoll steam electric power generating facilities, final report. San Antonio TX, variously paged.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GROESBECK
INTERSTATE 45
MC LENNAN
STEELE CREEK
LAKE LIMESTONE
FREESTONE
LEON
BUFFALO
ST. HWY 7
MAKE-UP WATER PIPELINE
ST. HWY 14
TWIN OAK RESERVOIR
FALLS
ROBERTSON
BREMOND
FM 46
FM 979
Twin Oak Station
WALNUT
FRANKLIN
CALVERT
U.S. HWY 79
TOSES Project Site Boundary
ST. HWY OSR
NAVASOTA RIVER
BRAZOS
HEARNE
MADISON
GRIMES
BRAZOS RIVER
MILAM
BURLESON
BRYAN
1
2
3
4
N
LIGNITE DEPOSIT
1 - Axtell-Tabor
2 - Silsted-Padina
3 - Nahatche-Uhland
4 - Crokett-Wilson
SCALE: 1" = 8 miles

Figure 6-2. Major soil units in the vicinity of the TOSES.

Table 6-3. Properties of general soil associations in the TOSES project area.

Soil Associations		Depth[1] (Inches)	Texture	Cropland[2] Potential	Pastureland[2] Potential	Rangeland[2] Potential	Additional Characteristics
Axtell - Tabor (Timbered Upland)	Axtell	0-8	Fine sandy loam	Medium	Medium	Low	0-5% slope; strongly acid; very slowly permeable; high shrink-swell potential; poor topsoil; massive, hard surface
		Below 8	Clayey				
	Tabor	0-14	Fine sandy loam	Medium	Medium	Medium	
		Below 14	Clayey				
Silstid - Padina (Timbered Upland)	Silstid	0-31	Sandy	Medium	Medium	Medium	0-5% slope; strongly acid; moderately permeable; poor topsoil
		Below 31	Sandy clay loam				
	Padina	0-50	Sandy	Low	Medium	Low	
		Below 50	Sandy clay loam				
Crockett - Wilson (Prairie Upland)	Crockett	0-8	Fine sandy loam	Medium	Medium	Medium	0-5% slope; slightly acid to neutral; very slowly permeable; high shrink-swell potential; massive, hard surface; poor topsoil
		8 - Deep	Clayey				
	Wilson	0-5	Clay loam	Medium	Medium	Medium	
		5 - Deep	Slightly clayey				
Nahatche Uhland (Bottomland)	Nahatche	0-8	Clay loam	Medium	High	High	0-1% slope; slightly to strongly acid; flood-prone; good topsoil accept in wet areas
		8 - Deep	Varied layers				
	Uhland	0-9	Fine sandy loam	Medium	High	High	
		9 - Deep	Loamy and sandy				

[1] Deep - greater than 40 inches.

[2] Low -- limitations difficult or costly to overcome; medium--limitations can be tolerated or overcome by general and practical means; high--limitations can be easily overcome.

Source: Adapted from: Soil Conservation Service. 1978a. General soil map, Limestone County, Texas. US Department of Agriculture, Washington DC, 1 sheet.
Soil Conservation Service. 1979. General soil map, Robertson County, Texas. US Department of Agriculture, Washington DC, 1 sheet.

the TRC. The TRC determination will consider soil information from the Soil Conservation Service (SCS) as well as historic land use.

Some specific soil chemistry information from samples collected around Twin Oak Reservoir (Figure 6-3) is presented in Table 6-4. Levels of boron, cadmium, selenium, and zinc were found to be higher than the national average, but well within the US range of normal values.

6.1.2 Environmental Consequences From the No Action Alternative

If no action is taken to continue to develop the proposed power plant and associated facilities, the topography, geology, and soils will remain much the same as described in Section 6.1.1. Should TUSI stop construction activities, it is expected that dynamic processes, namely erosion and deposition, are likely to produce some changes over time. However, these natural changes, measured on a geologic time scale, are much slower than the more immediate changes associated with the construction and operation of a mine and power plant.

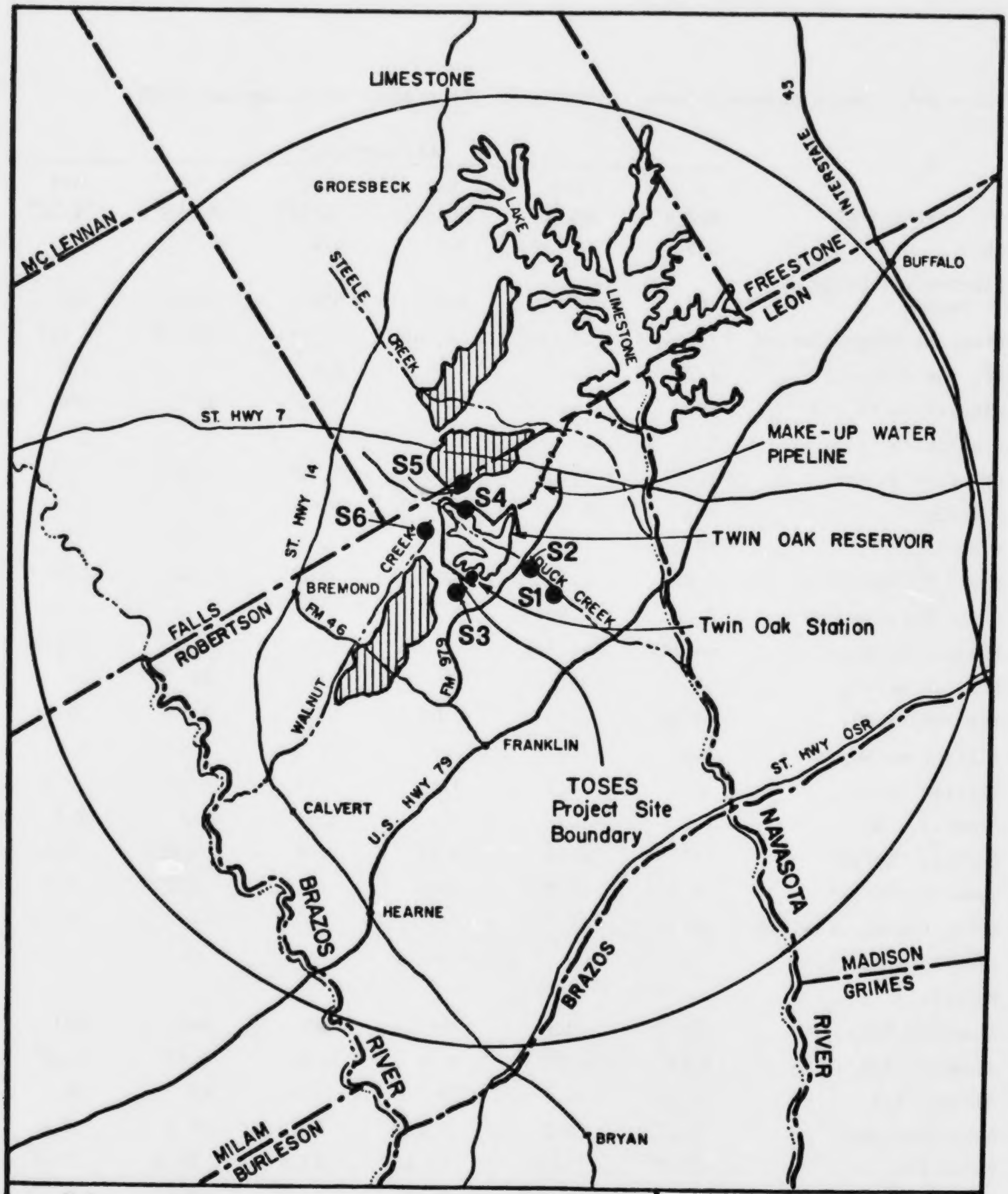
Effects that have already occurred due to construction to date include clearing of vegetation for Twin Oak Reservoir and some site clearing. Some erosion has resulted from these activities.

6.1.3 Environmental Consequences From Construction and Operation of the Proposed Projects

6.1.3.1 TOSES and Associated Facilities

Topography. The topography of the Twin Oak project site will be changed during construction to accommodate the proposed TOSES and associated facilities. Drainage patterns will be altered and the overall topography of the project site will be more level. No adverse impacts to the topography will result due to operation of the TOSES.

Geology. Land clearing, excavation, and leveling during site preparation and construction on the Twin Oak project site will result in conversion of up



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STEELE CREEK
LAKE LIMESTONE
INTERSTATE 45
FREESTONE
LEON
BUFFALO
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MAKE-UP WATER PIPELINE
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S4
S6
ST. HWY 14
CREEK
TWIN OAK RESERVOIR
S2
DUCK CREEK
S1
BREMOND
FM 46
FALLS
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Twin Oak Station
S3
FM 979
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MADISON
GRIMES
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BRAZOS
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BURLESON
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▥ LIGNITE DEPOSIT
SCALE: 1" = 8 miles

Figure 6-3. Location of soil sampling sites in the TOSES project area.

Table 6-4. Soils chemistry data collected at the project area, January 1980.

	SOIL SAMPLES					
PARAMETER	S-1 mg/kg*	S-2 mg/kg*	S-3 mg/kg*	S-4 mg/kg*	S-5 mg/kg*	S-6 mg/kg*
pH	6.5	6.8	6.0	6.3	7.3	8.3
Biochemical Oxygen Demand	266	254	514	524	424	152
Chemical Oxygen Demand	10,846	13,182	58,840	40,791	38,078	8,917
Oil and Grease	1.7	1.6	4.5	0.6	0.4	0.5
Alkalinity (M.O.)	90	142	79	241	321	484
Alkalinity (P)	0	0	0	0	0	0
Chloride as Cl	1,153	1,180	1,237	1,325	1,662	1,237
Chlorine	1.1	0.9	0.9	0.6	0.1	0.9
Fluoride	0.5	0.5	0.5	0.5	0.5	0.5
Total Phosphorus-P	6.86	1.40	2.10	48.60	1.82	0.57
Ortho Phosphate-P	1.76	0.60	0.76	44.0	1.41	0.19
Sulfate as SO_4	46,122	44,229	41,398	44,319	2,287	38,805
Sulfite as SO_2	30	35	33	25	18	34
Nitrite as NO_2	0.01	0.05	0.03	0.73	0.07	0.01
Nitrate as NO_3	2.1	1.8	1.9	11.3	2.6	1.3
Bromide as Br	0.1	0.1	0.2	0.1	0.1	0.1
Ammonia - N	1.2	1.7	3.9	5.8	9.3	2.5
Phenols (Total)	0.05	0.02	0.01	0.02	0.01	0.01
Cyanide (Total)	0.2	0.2	0.2	0.2	0.2	0.2
Total Dissolved Solids	--	--	--	--	--	--
Suspended Solids	--	--	--	--	--	--
METALS:						
Aluminum (Al)	376	320	539	408	645	651
Arsenic (As)	0.12	0.08	0.28	0.59	0.31	0.08
Barium (Ba)	31	21	33	26	67	36
Beryllium (Be)	0.2	0.2	0.2	0.2	0.2	0.2
Boron (B)	55.5	55.5	55.5	55.5	55.5	55.5
Cadmium (Cd)	0.13	0.13	0.13	0.13	0.13	0.13
Chromium (Cr)	0.30	0.20	0.50	0.40	0.50	0.50
Cobalt (Co)	2.21	1.65	1.54	1.87	3.86	2.32
Copper (Cu)	0.93	0.65	1.11	1.67	1.94	0.83

Table 6-4. Soils chemistry data collected at the project area , January 1980 (concluded).

	SOIL SAMPLES					
PARAMETER	mg/kg*	mg/kg*	mg/kg*	mg/kg*	mg/kg*	mg/kg*
Iron (Fe)	391	524	589	588	725	339
Lead (Pb)	4.0	4.0	5.8	5.8	6.7	4.0
Magnesium (Mg)	59	88	179	141.0	200	110
Manganese (Mn)	68	46	217	107	239	45
Mercury (Hg)	0.004	0.004	0.031	0.021	0.010	0.009
Nickel (Ni)	2.5	2.5	2.5	2.5	2.5	2.5
Selenium (Se)	0.88	1.30	1.72	1.36	2.67	3.56
Silver (Ag)	1.99	0.39	0.39	0.39	0.39	0.39
Uranium (U)	-- **	-- **	-- **	-- **	-- **	-- **
Vanadium (V)	6.5	6.5	6.5	6.5	6.5	6.5
Zinc (Z)	1.26	2.30	3.38	70.58	16.40	60.17
Molybdenum (Mo)	0.68	0.68	0.68	0.68	0.68	0.68

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* Reported on a dry basis

**Poor sensitivity - results not reported

Source: Texas Utilities Service, Inc. 1980. Environmental information document for Twin Oak electric station, Robertson County, Texas. Prepared for USEPA, Region VI. Dallas TX, variously paged.

to 3,393 acres into an industrial site. Long-term displacement of some surface soils and shallow subsurface geologic formations will result. Owing to the areas involved, the impacts to geologic resources are considered minimal. No significant adverse geological impacts are expected due to the operation of the TOSES.

Minerals. No impacts are expected to mineral resources.

Soils. The primary impact to soils from site preparation and construction activities on the Twin Oak project site will be the increased potential for erosion of cleared areas. These areas can be revegetated and if planned erosion prevention measures (matting, mulching, replanting, etc.) are successful, erosion during construction will be minimized. Although no prime farmland determination has been made for the project site, the productivity of soils directly disturbed by construction activities will be lost.

6.1.3.2 Transport Systems

Topography. No significant changes in topographic characteristics are expected due to the construction or operation of transportation systems in the project area.

Geology. Effects from construction and operation of transport systems will result in minor changes in surface geological characteristics. None of these effects is expected to be significant.

Minerals. No significant effects on mineral deposits are expected from construction and operation of the proposed transport systems.

Soils. Erosion will result during construction, and to a lesser degree, during maintenance of all transport facilities sites, especially those located on steep slopes. Rapid, effective revegetation and/or other erosion suppression techniques will lessen the erosion. Impact to prime farmland soils cannot be determined accurately at this time due to a lack of site-specific data.

6.1.3.3 Mine

Topography. Some drainage pattern changes will occur due to mining and the placement of overburden in mined areas. However, the relatively flat topography of the mine sites is not expected to undergo major surface contour changes. Some change in surface topography is inevitable because of raised elevations in replaced overburden. Removal and mixing of overburden destroys compaction and the mixing of air causes a "swell" in the volume of the replaced material. Although natural compaction will occur and reclaimed soils will subside considerably during the first 1 to 3 years, elevations at the mine sites are likely to remain a few feet higher (possibly as much as 20 feet) than surrounding areas. This could create some elevated areas with increased erosion potential, especially around the periphery of mine sites.

The mine pit remaining after the last stripping sequence will also alter the topography. Some of the surface drainage can be directed to the pit to form an end lake, instead of leaving a potentially dangerous and unsightly open pit. If properly developed, end lakes can enhance the aesthetic and recreational values of the area. Post-mining and reclamation techniques required by TRC regulations are aimed at assuring the overall adverse effects on topography and actual changes in flow direction in the watershed should be minor.

Geology. Existing stratigraphy in all mining areas will be lost and replaced by a homogenous mixture of geologic strata. Major environmental considerations include the potential exposure to air of acid-forming pyritic materials and permanent alteration of the hydrologic setting. The overall potential impacts directly affecting the geology of the mine sites are insignificant, except for the indirect effects on groundwater (See Section 6.2.3).

Minerals. Near-surface mineral deposits other than lignite are minimal and should not be significantly affected. However, it is likely that oil and gas wells will be encountered and care must be taken to insure that mining activities remain a safe distance away from each well (normally a 100 foot radius). The majority of the lignite in the mine areas will be removed during the life of this project. This mineral extraction constitutes an irretrievable commitment of this resource.

Soils. The potential for soil erosion during mining and reclamation activities is a major environmental concern. Clearing of vegetation will greatly increase the potential for erosion at the mine sites. To minimize erosion, immediate mining, leveling, and effective reclamation is necessary. Sedimentation ponds will be needed at strategic locations to curb erosion and collect surface runoff during clearing and dewatering processes.

The most significant impact of mining on soils will be the alteration of the present soil systems and characteristics. The permeability of the soil in the mined areas following mining is likely to increase. Most of the mine site is covered by the loamy and clayey Axtell-Tabor soil association which is generally of low permeability. The mixing of soil during overburden handling should increase the porosity and permeability of these soils significantly. This will enhance recharge to groundwater supplies where recharge zones intersect the mining sites.

The method used to remove soil and overburden is also important. Although site-specific information is not presently available, information from other studies revealed that the random mixing of soils of the nearby Calvert Bluff with overburden during mining resulted in increased potential for deposition of pyritic material at or near the surface. The pyrite then oxidizes, presenting increased acidic conditions in the topsoil and potential acid leachate problems. A site-specific investigation is generally necessary to determine the full potential for this to occur. This acidic condition can also alter the productivity of the soil. "Crusting" of fine textured soils with little organic matter at the surface and "hot spots" (reclaimed areas of high acidity and low productivity when untreated) are known to develop. Although fertilization can mitigate reduced soil productivity in reclaimed areas to some degree, conditions may worsen when use of fertilizer is discontinued or the rate of application and maintenance are reduced. Although permeability and water holding capacity of the upper few feet may increase, random mixing the overburden will likely dilute natural nutrients that usually occur in surface soils. However, a soil analysis of the strip mine spoil bank at Fairfield, Texas for the applicant revealed that overburden material can be a better growth medium than native soils which are quite often leached of most nutrients. More detailed information on mining plans, methods of soil removal, reclamation, and revegetation will be specified by TUGCO in their surface mining permit application to be submitted to the TRC. TUGCO has indicated that when overburden materials are found to contain pyrites in concentrations high enough to create problems for reclamation, those materials will be selectively handled and isolated.

A detailed soil survey is not available for the mining sites, therefore a determination of the presence of prime farmland soils and potential impacts to these soils has not been made. However, due to the large amount of acreage, it is possible that at least a small percent of the soils will meet the TRC criteria for prime farmland and will be subject to reclamation according to the specifications in the surface coal mining regulations (Section .051.07.04.620.625) dated 1 May 1980. It is probable that some soils on the mine sites will meet the Soil Conservation Service criteria for classification as prime farmland soil, but will not have been used for agricultural purposes for 5 out of the previous 10 years. Because of non-use, these soils would not be classified as prime farmland by the TRC and would not be subject to reclamation under the prime farmland criteria. It is highly probable that the prime farmland characteristics of these soils would be lost. It is not possible at this time to quantify the acreages involved if any, since a soil survey is not available.

6.2 GROUNDWATER

6.2.1 Existing Conditions

The geologic structure and hydraulic properties of aquifers in the project area, as well as the quantity and quality of groundwater, are presented in this section.

6.2.1.1 Hydrology

The geologic formations (Simsboro and Calvert Bluff) that contain the groundwater in the project area have already been described. The Simsboro and Clavert Bluff aquifers are part of the Wilcox Group which in turn is part of the regional Carrizo-Wilcox aquifer. Sands of the Simsboro Formation

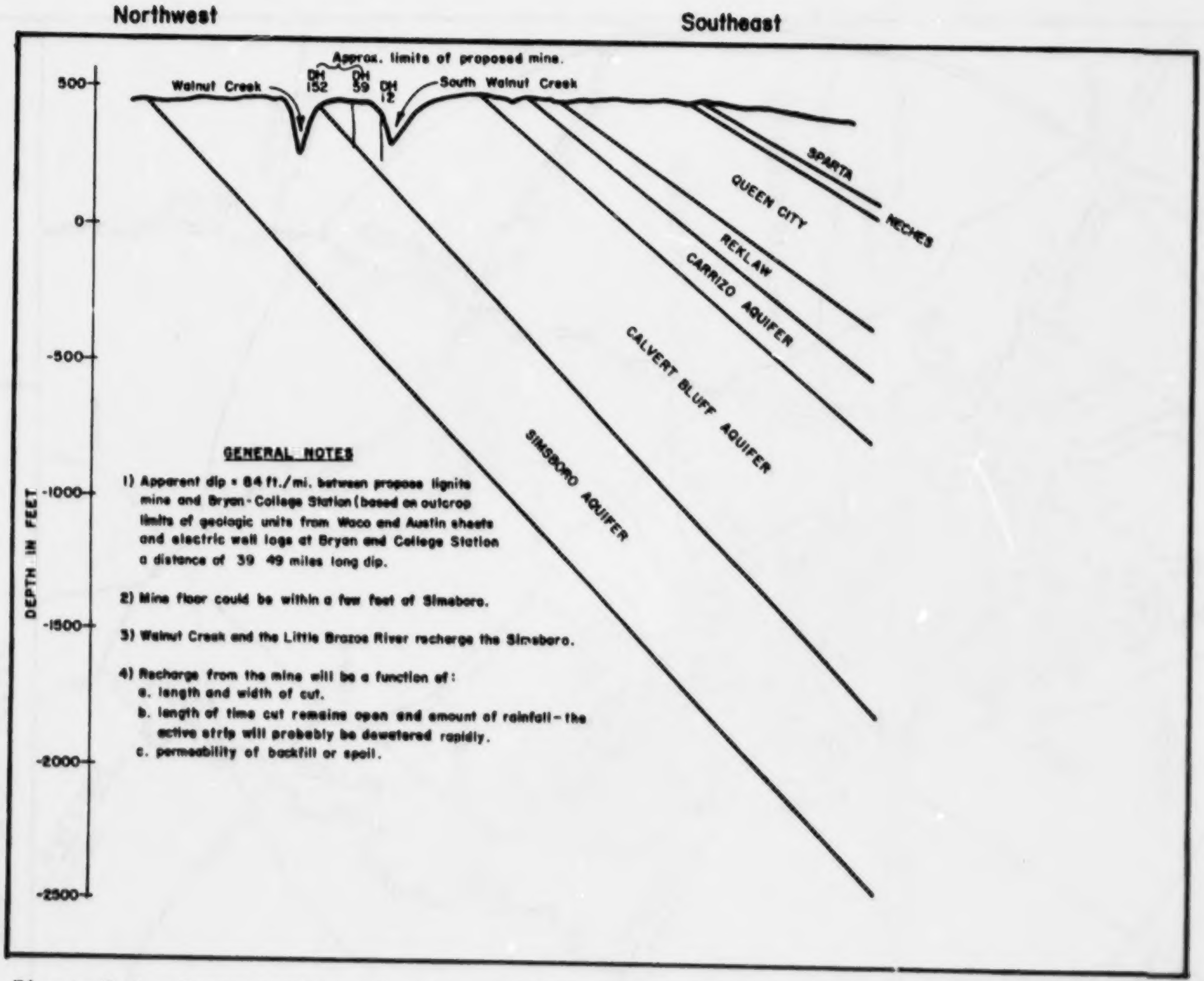
(Simsboro sands) are high in permeability, with available hydraulic conductivity values ranging from 18 to 60 feet per day. Clays of the Calvert Bluff lie on top of the Simsboro sands and are similar in hydraulic conductivity to Simsboro sands (Henry, Basciono, and Duex 1980). The direction of groundwater flow is normally to the southeast. A cross-sectional depiction of these aquifers is presented in Figure 6-4. The angle of dip is exaggerated for purposes of clear illustration.

The TOSES project site is located near the center of the Calvert Bluff outcrop (Figure 6-5). The mining sites occur primarily on outcrops of the Calvert Bluff and Simsboro aquifers. In addition, water-bearing alluvium deposits that serve as recharge areas are associated with Steele Creek, Walnut Creek, and Duck Creek (Figure 6-5).

6.2.1.2 Quantity

The thickness of the water-bearing strata is important in determining quantities of stored groundwater. Aquifers in the project area range in thickness from less than 100 feet, to as much as 2,200 feet, 50% of which is water-bearing sands (Texas Water Development Board 1977). Major water-bearing zones are often associated with sand channels. Large capacity wells in the project area yield quantities of water ranging from 300 gallons per minute (gpm) to 3,000 gpm. Safe annual withdrawal rates to the year 2030 were estimated to be 213.2 thousand acre-feet (7 billion gallons) per year compared to a withdrawal of 59.2 thousand acre-feet (2 billion gallons) in 1974 (Texas Water Development Board 1977). A safe annual reserve of 154 thousand acre-feet (5 billion gallons) per year between 1974 and 2030 can be estimated from these data. This calculation is for all groundwater in the area included in Section 5 of Figure 6-9. For the Carrizo-Wilcox aquifer in the Brazos River Basin, available groundwater projections presently are estimated at 132.8 thousand acre-feet (4.3 billion gallons) per year, declining slightly by 2030 to 129.3 thousand acre-feet (4.2 billion gallons) per year.

The Wilcox aquifer averages about 70 feet below ground surface in the project area. As would be expected, the water table (level) is shallower in lowlands and deeper in upland areas. The closest well for which water level data is


Northwest
Southeast
Approx. limits of proposed mine.
Walnut Creek
DH 152
DH 59
DH 12
South Walnut Creek
SPARTA
NECHES
QUEEN CITY
REKLAW
CARRIZO AQUIFER
CALVERT BLUFF AQUIFER
SIMSBORO AQUIFER
DEPTH IN FEET
500
0
-500
-1000
-1500
-2000
-2500

GENERAL NOTES

1) Apparent dip = 84 ft./mi. between propose lignite mine and Bryan-College Station (based on outcrop limits of geologic units from Waco and Austin sheets and electric well logs at Bryan and College Station a distance of 39 49 miles long dip.

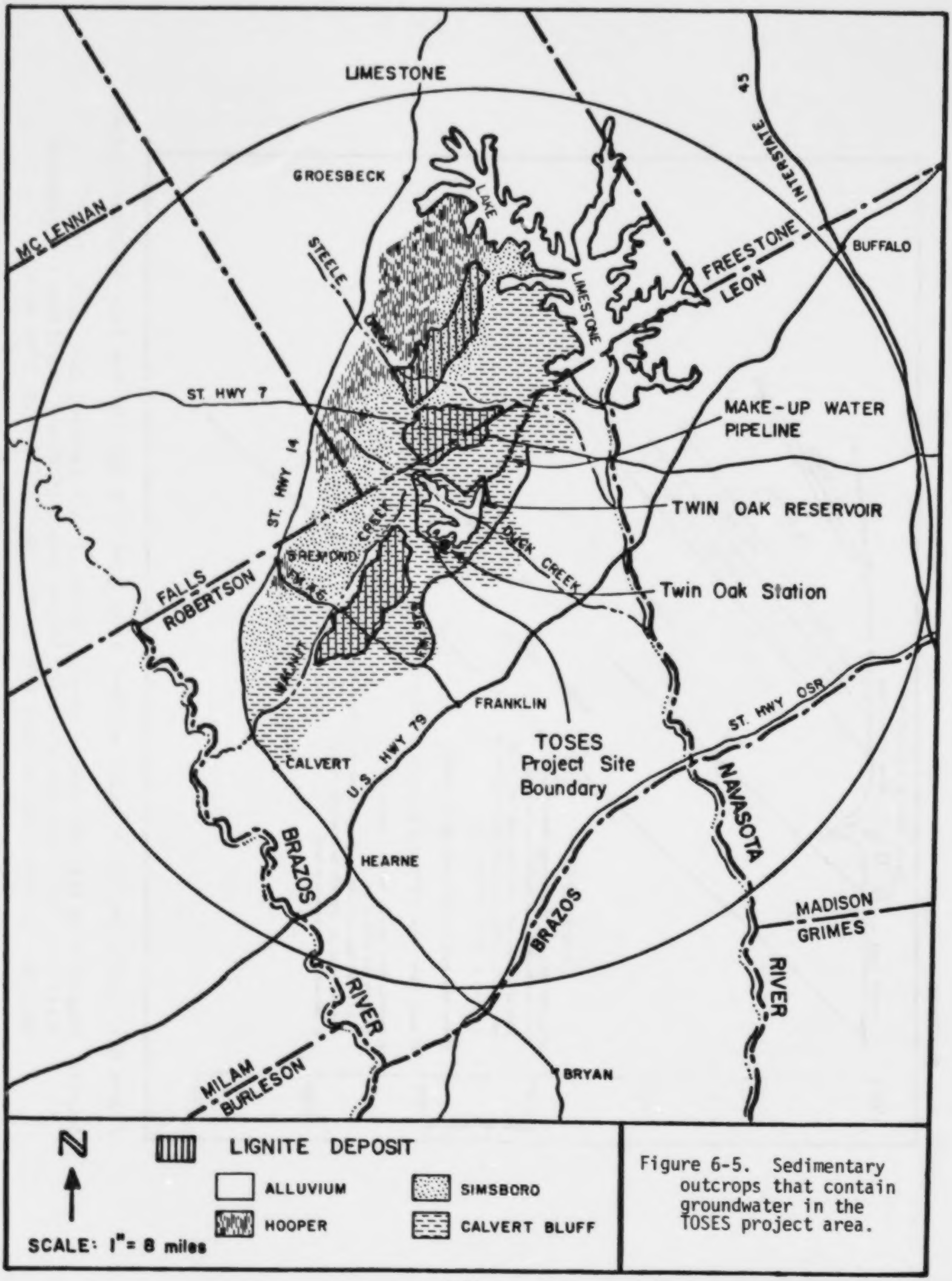
2) Mine floor could be within a few feet of Simsboro.

3) Walnut Creek and the Little Brazos River recharge the Simsboro.

4) Recharge from the mine will be a function of:
   a. length and width of cut.
   b. length of time cut remains open and amount of rainfall - the active strip will probably be dewatered rapidly.
   c. permeability of backfill or spoil.

Figure 6-4. Cross-section of major aquifers associated with the southern Twin Oak mining sites.

Source: Adapted from National Forest Service, National Soil Service, Inc. 1978. Texas Utilities, Inc. Twin Oak electric station impact of mining operations - groundwater quality. College Station water well study. Dallas TX, 5 pp. plus maps.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LIGNITE DEPOSIT
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HOOPER
CALVERT BLUFF
SCALE: 1" = 8 miles

Figure 6-5. Sedimentary outcrops that contain groundwater in the TOSES project area.

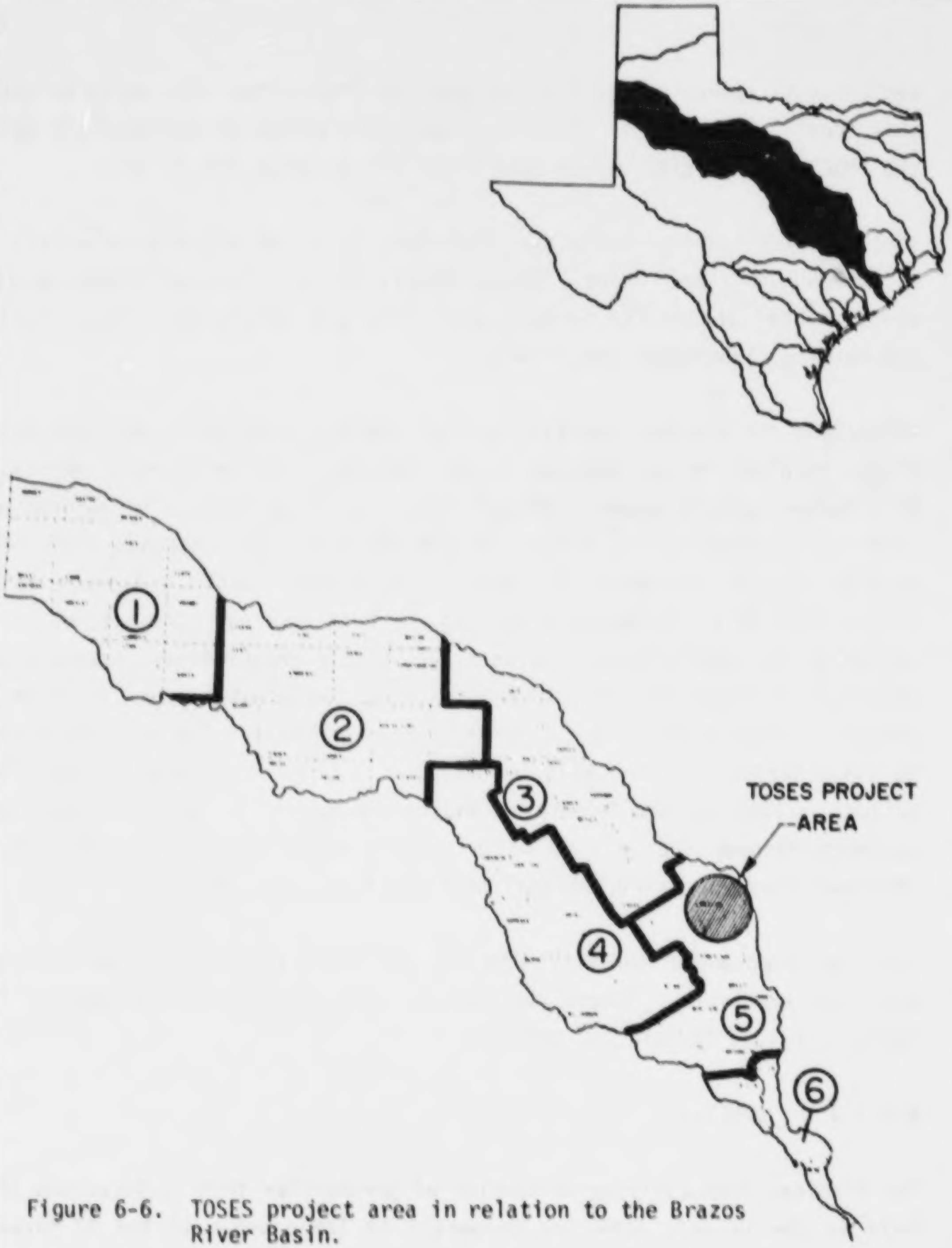

TOSES PROJECT AREA
①
②
③
④
⑤
⑥

Figure 6-6. TOSES project area in relation to the Brazos River Basin.

Source: TDWR 1977, Continuing Water Resources Planning and and Development for Texas, Austin, TX, variously paged.

available is approximately 4 miles from the TOSES site. The depth to water at this location is 60 feet. This is roughly indicative of the depth to water at the TOSES project site, since both areas are at about 420 ft msl.

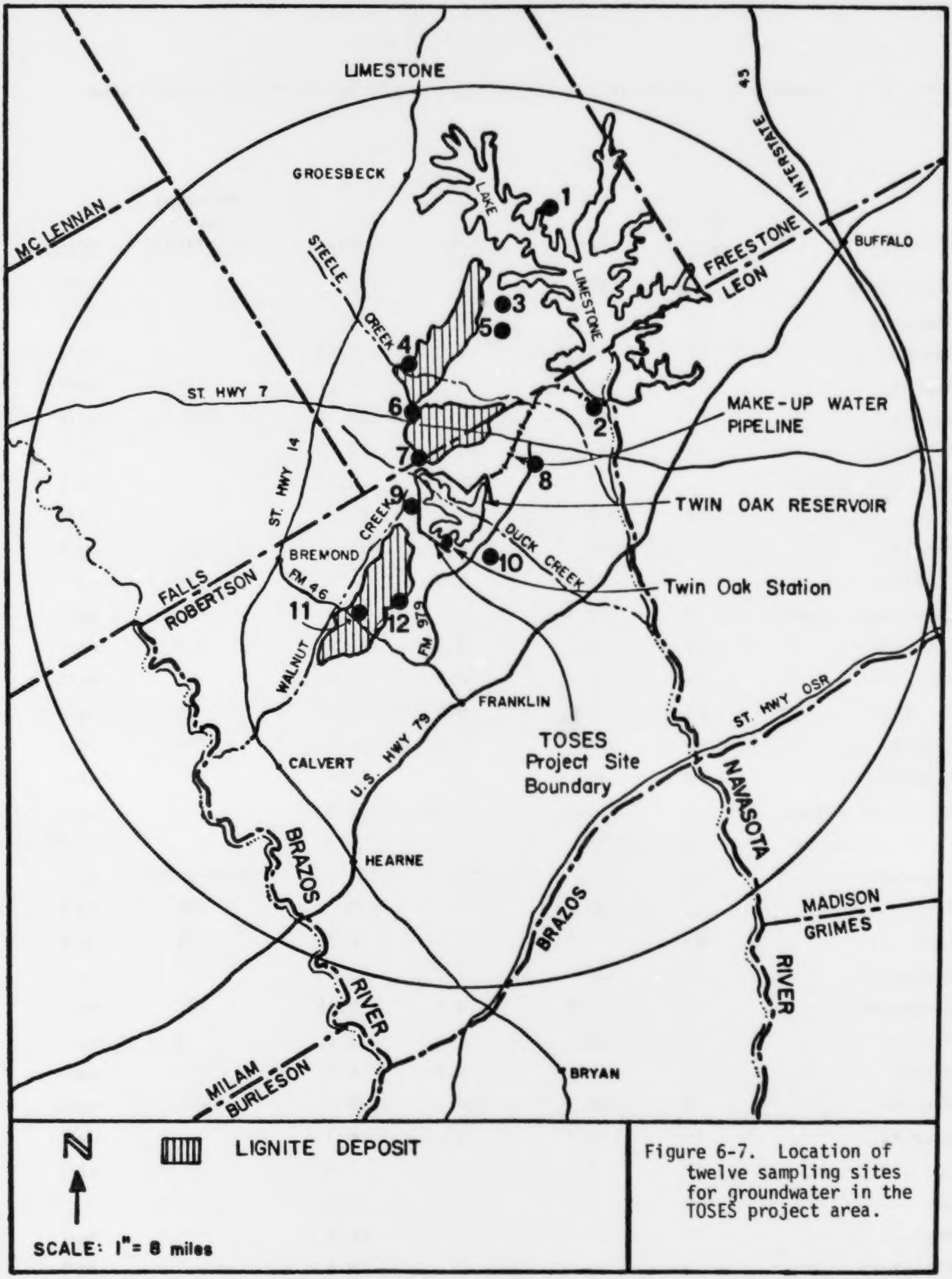
Shallow water-bearing strata are also expected in the alluvial materials along major streams (Duck Creek, Steele Creek, etc.). Because these areas are widely spaced across the project area, they are considered a minor factor in determining significant water levels.

At present the Simsboro aquifer receives recharge from three separate sources: direct rainfall on the outcrop, river recharge, and to a lesser degree, from groundwater leaking downward through overlying formations. The outcrop of the Simsboro aquifer is in excess of 200,000 acres and extends from central Bastrop County northward to southern Freestone County. Average rainfall ranges from 34 to 40 inches a year in the outcrop area. The outcrop is transected by the Little River, Brazos River, Little Brazos River, Navasota River, and their tributaries. Net runoff passing the Simsboro aquifer from these streams is approximately 4 million acre-feet annually. The poor drainage that is characteristic of the Wilcox Formation suggests that much of the precipitation falling on the overlying Wilcox Formation is absorbed and leaches downward through the various Calvert Bluff deposits into the Simsboro sands (National Forest Service/National Soil Services, Inc. 1981).

Specific groundwater quantity data for the TOSES project site and mining area were not available. Therefore, impacts will be based on the general information provided in this sub-section.

6.2.1.3 Quality

The findings from analyses of samples of groundwater from 12 locations (Figure 6-7) in the project area are presented in Table 6-5. Of the 42 parameters measured, six exceeded drinking water standards established by the Texas Department of Health (TDH). Iron, mercury, and pH were measured in concentrations in excess of drinking water standards in more than 10% of the samples. In six of 45 samples where iron content was measured, the concentration exceeded the TDH drinking water standard (300 ug/l); the mean iron content for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MAKE-UP WATER PIPELINE
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TWIN OAK RESERVOIR
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Twin Oak Station
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BRAZOS
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RIVER
MILAM
BURLESON
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LIGNITE DEPOSIT
SCALE: 1" = 8 miles

Figure 6-7. Location of twelve sampling sites for groundwater in the TOSES project area.

Table 6-5. Summary of groundwater analyses from wells in the TOSES project area, 1973.

Parameter	No. of Samples	High	Low	Mean	TDH Drinking Water Standards*	Units
Alkalinity	7	195	38	112	-	mg/l
Aluminum	42	1	1	1	-	mg/l
Ammonia	42	0.05	0.05	0.05	-	mg/l
Arsenic	47	32	5	7.6	50	ug/l
Barium	42	900	200	227	1000	ug/l
Beryllium	42	50	50	50	-	ug/l
Bio. Oxy. Demand	7	0.98	0.01	0.27	-	mg/l
Boron	48	5000	100	1283	-	ug/l
Bromide	7	1000	0.1	621	-	ug/l
Cadmium	49	7.8	0.5	1.1	50	ug/l
Chem. Oxy. Demand	7	52	4	23.8	-	mg/l
Chloride	49	466	6.9	87.0	300	mg/l
Chlorine	31	1.7	0.2	0.26	-	mg/l
Chromium	42	2.2	0.5	0.64	50	ug/l
Copper	49	350	0.3	18.6	1000	ug/l
Cyanide	49	90	1	23.9	-	ug/l
Dissolved Oxygen	49	8.4	0.05	2.9	-	mg/l
Fecal Coliforms	49	2058	1	6**	-	col/100 ml
Fluoride	16	1867	200	584	1400-1800*	ug/l
Iron	45	5500	1	233	300	ug/l
Lead	49	6.4	1	1.3	50	ug/l
Magnesium	7	20	2.8	10.8	-	mg/l
Manganese	42	3.6	0.3	0.46	50	mg/l
Mercury	49	26	0.5	2.1	2	ug/l
Nickel	42	49	0.5	4.4	-	ug/l
Nitrate	17	5000	100	2038	10000	ug/l
Nitrite	19	64.6	1	6.3	-	ug/l
Oil and Grease	49	5.3	0.1	1.4	-	mg/l
pH	49	7.6	4	6.5	7.0	-
Phenols	49	51	1	11.1	-	mg/l
Phosphate	7	25	5	9.6	-	mg/l

Table 6-5. Summary of groundwater analyses from wells in the TOSES project area, 1973 (concluded).

Parameter	No. of Samples	High	Low	Mean	TDH Drinking Water Standards*	Units
Phosphorus	7	280	1	82.4	-	ug/l
Selenium	42	1.25	1	1.0	10	ug/l
Silver	42	2.1	0.1	0.30	50	ug/l
Sulfate	46	17	0.5	2.6	300	mg/l
Sulfite	7	3	1	2.1	-	mg/l
Suspended Solids	49	245	1	46.8	-	mg/l
Temperature	49	28.62	10.70	21.6	-	C
Tot. Dissolved Solids	49	2100	21	493	1000	mg/l
Turbidity	42	100	4	80.0	-	% trans.
Vanadium	7	400	350	400	-	ug/l
Zinc	48	1019	1.6	180	5000	ug/l

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* Varies with temperature

**Log average

Source: Texas Utilities Service, Inc. 1980. Environmental information document for Twin Oak electric station, Robertson County, Texas. Prepared for USEPA, Region VI. Dallas TX, variously paged.

all samples was 233 ug/l. Five of the six samples were located downdip of the proposed lignite mine.

Five of 49 samples analyzed for mercury exceeded the State standard (2 mg/l). All five samples came from different wells. Thirty-seven of 49 samples analyzed for pH were below the standard (greater than 7.0), with the mean being 6.5 (slightly acidic).

The results from some of the sample analyses were unusual. For example, mercury samples from the same site range from undetectable limits to above TDH standards. Therefore, TDWR data were included from 126 wells in Robertson County and 6 wells in Limestone County from 1974 through 1977. These wells occur at the top of the Wilcox aquifer, or associated aquifers. In over 10% of the well samples, chloride, fluoride, hardness, iron, nitrate, pH, sulfate, and Total Dissolved Solids (TDS) levels were found to be in excess of the TDH drinking water standards. These data correlate with data from the TUSI study concerning iron and pH. Comparable data for mercury were not available.

In general, excessive iron levels occur primarily downdip of the Twin Oak project and mining sites. Excessive chloride levels occur primarily downdip of the northern mining site and on and adjacent to the southern mining site. Excessive TDS were found to exist throughout the project area. Groundwater in the project area and especially near the southern mining site is hard. Excessive nitrate levels, and pH values less than 7.0, occur in or near the southern mining site.

6.2.1.4 Usage

The primary use of groundwater in Limestone County is for municipal drinking water, while the primary use in Robertson County is irrigation (Texas Department of Water Resources 1981). Data illustrating the amount of water used by various categories are presented in Table 6-6. Data on use for several communities in the project area are presented in Table 6-7. The Franklin wells are approximately 8 miles and the New Baden well approximately 11 miles downdip of the southern mine site. The three remaining communities are updip of the mining sites.

Table 6-6. Use of groundwater (acre-feet) in Limestone and Robertson Counties for 1974 and 1977.

	Limestone County				Robertson County				Combined Total			
Use Category	1974	Percent	1977	Percent	1974	Percent	1977	Percent	1974	Percent	1977	Percent
Municipal	1039	66	960	64	2809	15	2364	15	3848	19	3324	19
Manufacturing	164	10	0	0	145	1	136	1	309	1	136	1
Steam electric	0	0	0	0	0	0	0	0	0	0	0	0
Irrigation	40	3	0	0	16009	83	12750	80	16049	77	12750	73
Mining (metals fuels, non-metals	172	11	398	26	5	1	0	0	177	1	398	2
Livestock	155	10	144	10	228	1	645	4	383	2	789	5
Total	1570	100	1502	100	19196	100	15895	100	20766	100	17397	100

Source: Adapted from Texas Department of Water Resources, Planning and Development Division, Economics Section. undated. Fresh water uses in Texas (computer print-out). Austin TX, 1 page per county.

Table 6-7. Groundwater from the Wilcox Aquifer used as public supply by municipalities in the TOSES project area.

Community	1978 Withdrawal in acre-feet	Number of Wells
Kosse	41.07	3
Bremond	108.40	unknown
Calvert	350.53	1
Franklin	227.53	2
New Boden	4.63	1

Source: Adapted from Texas Department of Water Resources 1981. Survey of ground and surface water use, use data file (computer print-out). Austin, TX, 1 sheet per community.

6.2.2 Environmental Consequences From the No Action Alternative

If no action is taken to develop the proposed TOSES, little change is anticipated in existing groundwater resource conditions. Quantities of groundwater from the Wilcox aquifer are adequate for all planned uses, including projected use for future area steam electric generation. The quality of groundwater in the project area except in certain instances meets existing drinking water standards and is generally satisfactory for human consumption and irrigation. However, there is the possibility of some contamination of groundwater in the project area from future mining of lignite. The extent of impacts depends on the existing chemical environment, and mining methods used at each mine. The major contamination threat is acidity (change in pH) due to the oxidation of pyritic materials.

6.2.3 Environmental Consequences From the Construction and Operation of the Proposed Projects

6.2.3.1 TOSES and Associated Facilities

Construction of the TOSES should have little or no effect on groundwater resources. Since most of the make-up water for operation of the TOSES will be derived from surface sources, no impacts are expected due to operation. Facilities, such as lignite storage piles and ash disposal ponds should have little impact, since it is proposed that these areas will be lined with impervious clay liners.

6.2.3.2 Transport Systems

Construction and operation activities associated with these facilities are not expected to affect adversely the groundwater resources in the project area.

6.2.3.3 Mine

The mining processes will alter the present geology wherever overburden is removed. The mixing of overburden will alter the groundwater hydrology at the mining site since, upon reclamation, the mixed overburden will have a much greater water holding capacity. Formerly impervious clay layers will be randomly mixed with sandy layers and thus, vertical permeability will increase in reclaimed areas. The effect on horizontal permeability is not as easily understood. It can be assumed that water will not recharge as readily as before into the Simsboro and Calvert Bluff aquifers due to: (1) the increased water holding capacity of the overburden, and (2) the aquifer strata no longer extending to the surface at the mine sites. However, if end lakes are left following mining, there will be direct recharge from any waters entering the pits. This should serve to compensate somewhat for reduced horizontal permeability in the overburden, making the alteration in groundwater hydrology of minor significance in regard to aquifer recharge.

The quantity of water should not be greatly affected at the mine sites. Once the surface mining procedures begin to reach depths of 50 to 70 feet, dewatering to remove some groundwater will be necessary for efficient mining. Some wells near the mine dewatering activity may have to be lowered to a level at or below the pit depth to ensure continued supplies of water. Impacts on overall water quantity should be minor, since the quantities removed are insignificant compared to available amounts downdip. Also, some water from the dewatering wells, if properly diverted, will re-enter the Wilcox aquifer at other locations outside of the mine boundary. The main environmental concern is the possible adverse soil erosion associated with dewatering if sedimentation ponds are not situated properly.

The quality of water immediately below and downdip of the mining sites may be altered slightly. This situation would arise mainly due to the leaching of acidic pyritic materials brought into contact with the air during overburden removal and reclamation. Any wells drilled on or near the mine sites following reclamation should not draw water from the Wilcox aquifer, but should go to a deeper groundwater source. Wells in the Wilcox aquifer within 1 to 2 miles downdip (southeast) should be carefully monitored during and after mining for possible changes. Groundwater naturally will become cleaner as it travels downdip. The closest recorded wells drawing from the Wilcox are from the City of Franklin. However, these wells are approximately 8 miles downdip from the southern mining site and should be far enough downdip to be safe from adverse effects due to increased acidity. Any wells updip from the mine sites, or in formations older (deeper) than the Wilcox, will be unaffected by any acidic alterations, since the flow direction is to the southeast, away from these areas.

Monitoring of water quality is especially important around mining sites in Limestone County where the primary use of groundwater is for municipal supplies. Although still important, the situation is not likely to be as critical from a public health standpoint in Robertson County where irrigation is the primary use of groundwater. However, the predominate use pertains to the county in general, and does not indicate the use of each individual well that may be affected near the mine sites.

The Surface Coal Mining Regulations of the TRC are intended to protect groundwater quality and recharge capacity. The quality and quantity of groundwater, infiltration rates, subsurface flow, and storage characteristics will be monitored in a manner acceptable to the TRC, to document the effects of surface mining activities on groundwater.

6.3 SURFACE WATER

6.3.1 Existing Conditions

Adequate and reliable information regarding surface water is essential for sound environmental and economic development. Surface water is utilized extensively throughout the power generating process. Without adequate information on surface water quality, quantity, and water rights, the generating process could be interrupted or shut down completely.

6.3.1.1 Hydrology

The project area lies in the Brazos River Drainage Basin (Figure 6-6). The Brazos River Basin is bounded on the north by the Red River Basin, on the south and west by the Colorado River Basin, and on the east and north by the Trinity and San Jacinto Rivers. The total drainage basin area is 45,573 mi^2. The Brazos River and Navasota River (a tributary of the Brazos River) are the two main rivers in the project area. The Navasota River watershed has a drainage area of about 2,211 mi^2.

The proposed TOSES project site lies on Duck Creek, a tributary of the Navasota River. Twin Oak Reservoir on Duck Creek will serve as a cooling reservoir for the TOSES. Duck Creek, upstream of the Twin Oak Dam, drains an area of 45 mi^2 in a southeasterly direction. The total areal yield of the reservoir is calculated as 4,465 acre-feet per year based on natural runoff (URS/Forrest and Cotton, Inc. 1974). The yield of the reservoir at the desired operating level (i.e., between the normal pool elevation of 401 ft msl and a minimum level of 395 ft msl) during the critical drought period (June 1947-February 1957) is zero acre-feet per year. At ultimate plant development the water requirements of 13,200 acre-feet per year will not be satisfied by natural runoff (URS/Forrest and Cotton, Inc. 1974).

Flood prone areas in and near the TOSES project site are illustrated in Figure 6-8. Bottomlands adjacent to Duck Creek and its tributaries were identified as a "Special Flood Hazard Area" (US Department of Housing and Urban Development 1977). Most of the flood hazard area in the TOSES project site will be inundated when Twin Oak Reservoir on Duck Creek is filled (TUSI 1980).

Mining for the fuel reserve for the TOSES will occur in Steele Creek and its tributaries (Davis Creek, Cox Creek, Owen Creek, and Willow Creek), and Walnut Creek and its tributary (South Walnut Creek). Steele Creek is a tributary of the Navasota River and flows in a southeasterly direction. Walnut Creek is a tributary of the Little Brazos River and flows in a southwesterly direction. The Little Brazos River merges with the Brazos River just west of Bryan, Texas.

Data from existing US Geological Survey (USGS) stream gauging stations identified in Figure 6-9 were used to represent general water quality of the mine area. Hydrologic data from USGS stations are presented in Tables 6-8, 6-9, and 6-10.

6.3.1.2 Water Quality

Overall water quality is relatively good in the Brazos River Basin, although the entire upper basin (not in the project area) is characterized by high dissolved solids due primarily to natural geological formations. The USGS stream

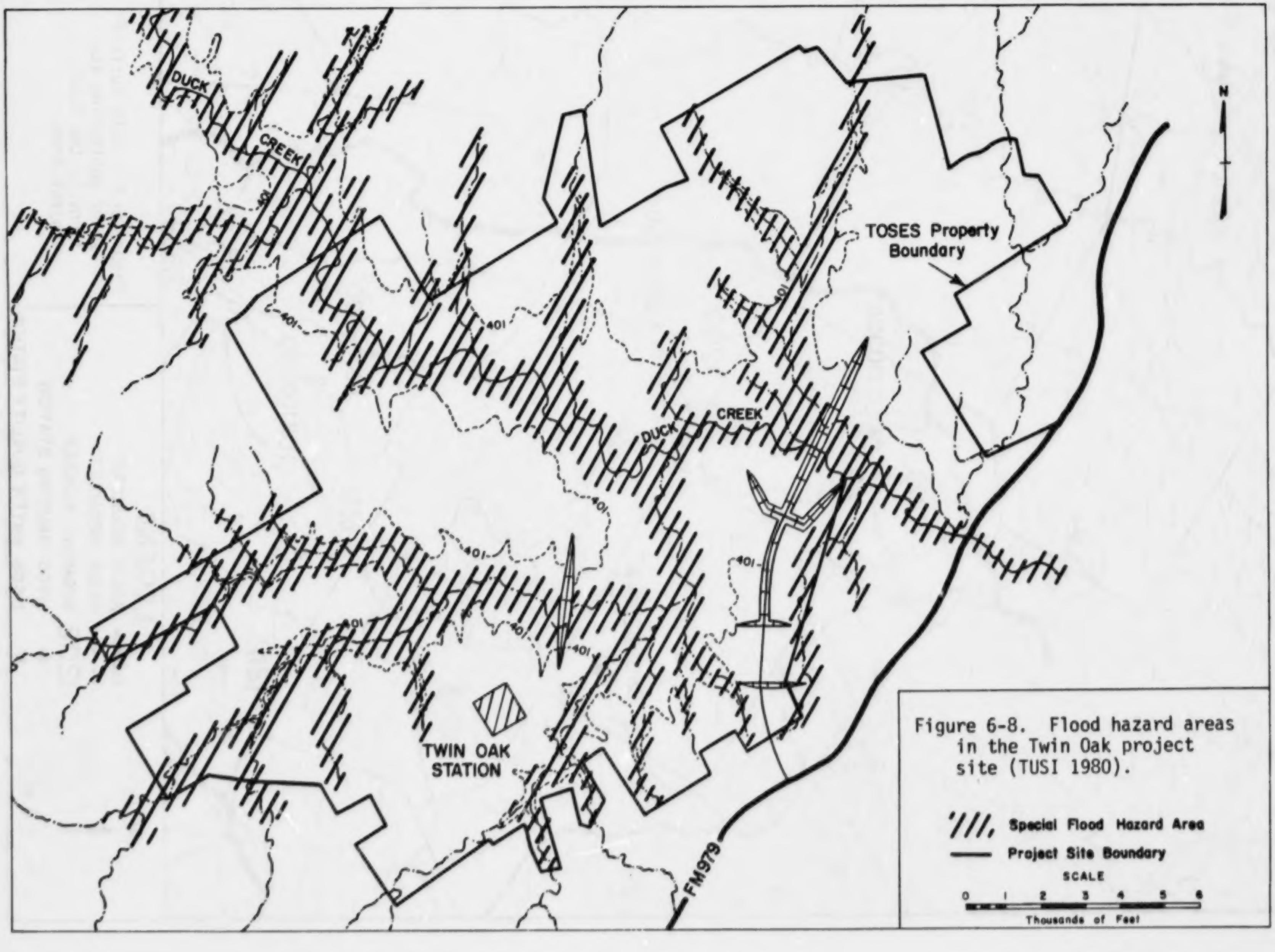
DUCK
CREEK
401
TOSES Property
Boundary
DUCK
CREEK
401
TWIN OAK
STATION
FM979
N
Special Flood Hazard Area
Project Site Boundary
SCALE
0
1
2
3
4
5
6
Thousands of Feet

Figure 6-8. Flood hazard areas in the Twin Oak project site (TUSI 1980).

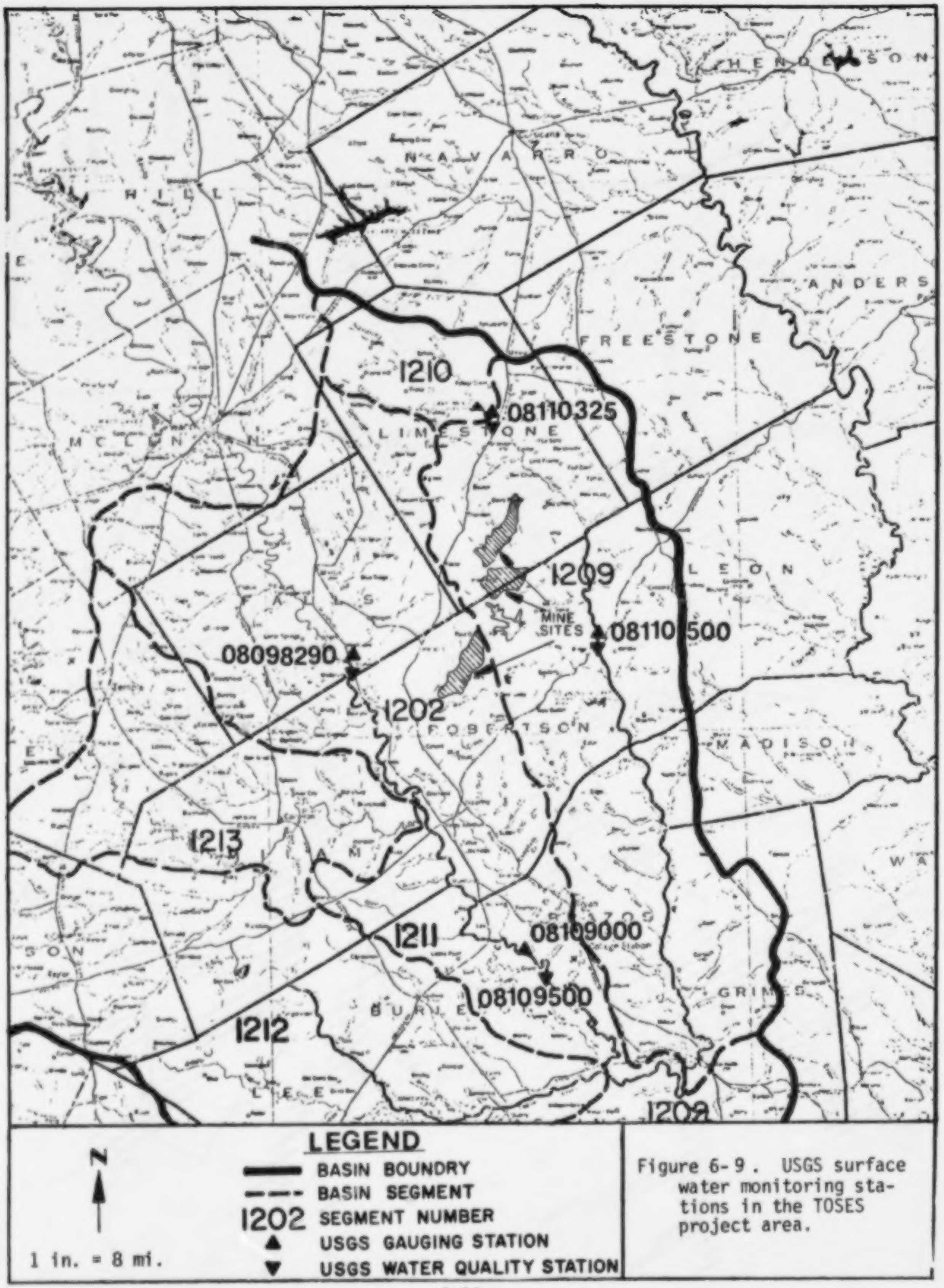
HENDERSON
NAVARRO
HILL
E
ANDERS
FREESTONE
1210
08110325
LIMESTONE
MCLENNAN
1209
LEON
MINE SITES
08110500
08098290
FALLS
1202
ROBERTSON
MADISON
1213
MILAM
WA
1211
BRAZOS
08109000
SON
08109500
BURLESON
GRIMES
1212
LEE
1208
LEGEND
BASIN BOUNDRY
BASIN SEGMENT
1202 SEGMENT NUMBER
▲ USGS GAUGING STATION
▼ USGS WATER QUALITY STATION
N
1 in. = 8 mi.

Figure 6-9. USGS surface water monitoring stations in the TOSES project area.

Table 6-8. Tabulation of data from streamflow gauging stations in the TOSES project area.

Stream	USGS Gauging Station No.	Drainage Area (mi.^{2})	Average Annual Runoff		Period of Record	
			(acre-ft)	(inches)	Begin	End
Navasota River	08110325	239	116,300	9.12	June 1978	Sep 1978
Navasota River	08110500	968	340,500	6.60	Mar 1924	Sep 1980
Brazos River	08098290	30,436	1,856,000	1.14	Oct 1965	Sep 1980
Brazos River	08109000	39,515	3,612,000	1.71	Aug 1899 Feb 1918 June 1926	Dec 1902 Jan 1926 Sep 1980

Source: US Geological Survey. 1980. Water resources data for Texas. Volume 2. San Jacinto River Basin, Basin, San Bernard River Basin, and Intervening Coastal Basin. Austin TX, 472 p.

Table 6-9. Duration of daily flow (ft.^{3}/sec.) from gauging stations in the TOSES project area.

Stream	USGS Gauging Station No.	Drainage Area (mi.^{2})	Flow in acre-ft./year Equaled or Exceeded for the Percent of Time Indicated					Period of Record
			99%	50%	20%	10%	1%	
Navasota River	08110325	239			NOT AVAILABLE			
Navasota River	08110500	968	0	18,403	951,122	635,488	5,368,131	1925 - 1978
Brazos River	08098290	30,436	54,963	750,814	174,618	4,180,041	19,325,534	1966 - 1978
Brazos River	08109000	39,515	114,269	1,314,704	3,009,006	9,235,611	38,303,410	1900 - 1978

Source: US Geological Survey. 1981. WATer data STOrage and REtrieval (WATSTORE). Dallas TX, computer printout.

Table 6-10. Seven day low-flow for various recurrence intervals from gauging stations in the TOSES project area.

Stream	USGS Gauging Station No.	Drainage Area (mi.^{2})	Annual low-flow in acre-ft./year for Seven Consecutive Days for Indicated Recurrence Intervals in Years					Period of Record
			1%	2%	5%	10%	20%	
Navasota River	08110325	239	NOT AVAILABLE					
Navasota River	08110500	968	587,852	514	254	254	0	1925 - 1978
Brazos River	08098290	30,436	NOT AVAILABLE					
Brazos River	08109000	39,515	1,291,950	267,639	146,731	106,342	81,293	1901 - 1978

Source: US Geological Survey. 1981. WATer data STOrage and REtrieval (WATSTORE). Dallas TX, computer printout.

segments included in the project area are segments 1202, 1209, 1210, and 1213 (Figure 6-9). Water quality in segments 1202 and 1213 is generally good. Violations of dissolved oxygen criteria have been observed in segments 1209 and 1210.

Rainfall runoff and discharge from the proposed Twin Oak project site will flow into the Navasota River through Duck Creek. Water quality sampling was performed at ten sites during 1973-1974 and at 3 of these 10 sites again in 1980 (Figure 6-10) on Duck Creek. A summary of the data collected for each parameter on Duck Creek is presented in Table 6-11. More detailed information on the water quality of Duck Creek can be found in Appendix C-2 of the applicant's Environmental Information Document (TUSI 1980).

Specific numerical water quality criteria have not been developed by the State for Duck Creek, however, segment 1209, within which Duck Creek is located, does have numerical standards (Table 6-12).

Of 45 parameters sampled at each of the sites on Duck Creek in 1980, 10 parameters on at least one occasion exceeded various standards or recommended concentrated limits of the TDWR, US Fish and Wildlife Service (USFWS), or Texas Department of Health (TDH). Table 6-11 presents the parameters for which standards or recommendations were violated, along with a description of the occurrence.

Wastewater discharges from the TOSES will be regulated by applicable sections of 40 CFR 423 "Effluent Guidelines and Standards for Steam Electric Power Generating Stations" (EPA 1978). Because the TOSES has been designated a "new source" by EPA, Standards of Performance for New Sources are applicable (40 CFR 243.15). EPA's draft New Source NPDES permit for TOSES is contained in Appendix C. Duck Creek has recorded higher natural levels of pH, Total Suspended Solids (TSS), and iron than those limits listed in the NSPS (TUSI 1980).

The proposed mine sites lie in the Brazos River Basin. Potential contamination of water quality could occur in Steele Creek, Duck Creek, Walnut Creek, Navasota River, and/or Brazos River. Information on water quality

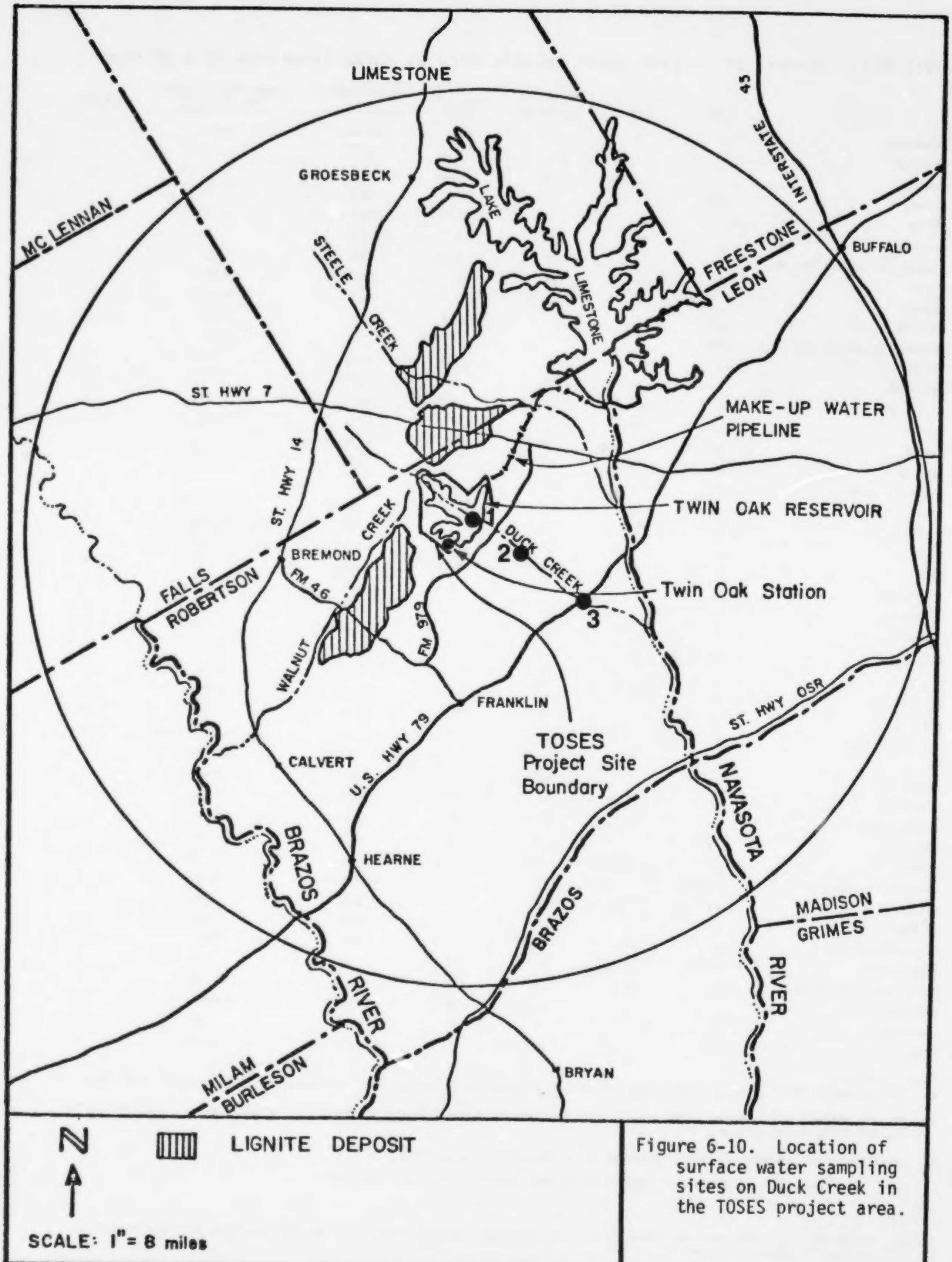
LIMESTONE
INTERSTATE 45
GROESBECK
LAKE
LIMESTONE
MC LENNAN
FREESTONE
LEON
BUFFALO
STEELE
CREEK
ST. HWY 7
MAKE-UP WATER
PIPELINE
ST. HWY 14
TWIN OAK RESERVOIR
1
DUCK
CREEK
2
BREMOND
CREEK
FM 46
FALLS
ROBERTSON
Twin Oak Station
3
FM 979
WALNUT
FRANKLIN
TOSES
Project Site
Boundary
ST. HWY OSR
CALVERT
U.S. HWY 79
NAVASOTA
RIVER
BRAZOS
RIVER
HEARNE
BRAZOS
MADISON
GRIMES
MILAM
BURLESON
BRYAN
N
▥ LIGNITE DEPOSIT
SCALE: 1" = 8 miles

Figure 6-10. Location of surface water sampling sites on Duck Creek in the TOSES project area.

Table 6-11. Summary of surface water quality data at three locations on Duck Creek.

Parameter	High	Low	Number of Readings	Mean	Measurement Unit	Recommended Limit or Standard	Referen
Alkalinity	121	5	7	82	mg/L	None	-
Aluminum	2.02	.64	3	1.34	mg/L	5.0	a
Ammonia	.11	.03	3	.07	mg/L	0.02	b
Arsenic	40	5	17	14	ug/L	50	c
Barium	750	216	8	284	ug/L	1,000	c
Beryllium	20	20	3	20	ug/L	11	b
Biochemical Oxygen Demand	4	.5	7	2.3	mg/L	None	-
Boron	5600	200	24	1918	ug/L	5,000	a
Bromide		100	6	283	ug/L	None	-
Cadmium	30	.5	11	4.7	ug/L	10	c
Chemical Oxygen Demand	64	1	7	29	mg/L	None	-
Chloride	230	31	27	60.9	mg/L	100	d
Chlorine	1.7	.1	5	.8	mg/L	None	-
Chromium	10	.18	6	5.30	ug/L	50	c
Cobalt	50	50	3	50	ug/L	None	-
Copper	90	.45	27	15.1	ug/L	500	a
Cyanide	100	20	20	34	ug/L	None	-
Dissolved Oxygen	12	295	27	6.87	mg/L	5.0	d
Fecal Coliforms	3200	10	26	522	/100 ml	200/100/ml	d
Fluoride	1400	50	13	638	ug/L	1800-1400	c
Iron	3580	3.2	18	762.2	ug/L	300	c
Lead	100	1.0	8	38.7	ug/L	50	C
Magnesium	17	6.2	7	10.9	mg/L	0.05	b
Manganese	641	.32	13	91.21	ug/L	50	c
Mercury	70	.5	10	13.0	ug/L	2	c
Molybdenum	50	50	3	50	ug/L	None	-
Nickel	25	1.5	16	7.8	ug/L	None	-
Nitrate	6550	100	11	1363	ug/L	10,000	c
Nitrite	78	1	13	14.8	ug/L	10,000	a
Oil and Grease	36	0.0	26	3.20	-	No sheen on water	d
pH	7.9	5.5	27	7.09	-	6.5-8.5	d
Phenols	37	1	26	10.3	ug/L	None	-
Phosphate	45	.02	7	11.44	mg/L	None	-
Phosphorous	90	10	7	41	ug/L	None	-
Selenium	5	5	3	5	ug/L	10	c
Silver	11	0.05	16	3.31	ug/L	50	c
Specific Conductance	.86	.10	27	.358	m mho/cm	None	-
Sulfate	42	1.0	26	8.8	mg/L	300	c
Sulfite	3	1	7	1.7	mg/L	None	-
Suspended Solids	246	14	26	67.3	mg/L	None	-
Temperature	31.6	11.43	27	20.26	C	33.9	d
Total Dissolved Solids	1200	44.5	27	325.5	mg/L	1,000	c
Turbidity	82	4	21	40.5	% Transmittance	None	-
Vanadium	650	350	7	493	ug/L	100	a
Zinc	38	3.6	24	11.9	ug/L	5,000	c

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a. US Fish and Wildlife Service. 1978. Impacts of coal-fired power plants on fish, wildlife, and their habitats. FWS/OBS-78

b. US Fish and Wildlife Service. 1978. Ecological implication of geopressured-geothermal energy development, Texas-Louisiana FWS/OBS-78/60, Washington DC.

c. Texas Department of Health. 1977. Drinking water standards. Austin TX.

d. Texas Department of Water Resources. 1976. Texas water quality standards. Austin TX.

Source: Texas Utilities Services Inc. 1980. Draft environmental information document for Twin Oak Steam Electric Station, Ro
Dallas TX, variously paged.

Table 6-12. Texas Department of Water Resources water quality standards for Segment 1209 of the Brazos River Basin.

BRAZOS RIVER BASIN		WATER USES DEEMED DESIRABLE				CRITERIA						
SEGMENT											COLIFORM	
NUMBER	DESCRIPTION	CONTACT RECREATION	NONCONTACT RECREATION	PROPAGATION OF FISH & WILDLIFE	DOMESTIC RAW WATER SUPPLY	CHLORIDE (mg/l) avg. not to exceed	SULFATE (mg/l) avg. not to exceed	TOTAL DISSOLVED SOLIDS (mg/l) avg. not to exceed	DISSOLVED OXYGEN (mg/l) not less than	pH RANGE	FECAL/ (100ml) - log. avg. not more than (see Gen. Statement)	TEMPERATURE °F (see Gen. Statement)
1209	Navasota River - Brazos River confluence to Lake Mexia	X	X	X	X	100	50	400	5.0	6.5-8.5	200	93

Source: Texas Department of Water Resources. 1980b. The State of Texas water quality inventory. Austin TX, 540 p.

(water year October 1979 to September 1980) collected by TDWR at USGS sampling points on the Navasota River and the Brazos River, upstream and downstream of the mining area, were utilized to summarize the existing water quality condition of the mine sites. The sampling locations are illustrated in Figure 6-9, and the data presented in Table 6-13.

The TRC is responsible for regulating and issuing permits for surface mining operations in Texas. With regards to hydrological balance and water quality, the TRC is advised by the TDWR, and uses TDWR criteria in its evaluation of permit applications and proposed mine operations. The Twin Oak mining operation has already been designated as an "existing source" by EPA, thus the EPA New Source Performance Standards for the coal mining industry do not apply. EPA issued a NPDES for the Twin Oak mine effective 10 May 1982.

6.3.1.3 Water Supplies, Water Uses, and Water Rights

The existing major surface water developments in or near the project area include Lake Mexia, Camp Creek Reservoir, Bryan Utilities Reservoir, and Lake Limestone. Lake Mexia supplies the City of Mexia in the Trinity River Basin and other customers through the Bristone Municipal Water Department. Camp Creek Reservoir is owned by the Camp Creek Water Company, and is used for recreation. Bryan Utilities Lake provides cooling water for a steam electric power plant and is also used for recreation. Lake Limestone provides municipal, industrial, and irrigation water supplies, although its principal purpose will be to supply make-up water for the Houston Lighting and Power's (HL&P) Limestone electric generating station, and to the off-channel cooling reservoirs for the Oak Knoll and Twin Oak lignite-fueled steam electric plants to be constructed by Texas Utilities, Inc. on Steele Creek and Duck Creek in Limestone and Robertson Counties. The water uses in the project area (segments 1202, 1209, 1210, and 1213) are contact recreation, non-contact recreation, propagation of fish and wildlife, and domestic raw water supply.

Lake Limestone will eventually supply water to three major utility projects requiring 55,000 acre-feet per year (TUSI - 39,000 acre-feet; HL&P -12,400 acre-feet; Texas Municipal Power Authority (TMPA) - 3,600 acre-feet). An additional 4,000 acre-feet per year has also been reserved by the Brazos River Authority (BRA) to meet future municipal demands in the area.

Table 6-13. Water quality data from four (4) stations in the TOSES project area (water year October 1979 to 1980) (USGS 1980).

Station 08110500 - Navasota River Near Easterly

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	TEMPER-ATURE, WATER (DEG C)	HARD-NESS (MG/L AS CACO3)	HARD-NESS, NONCAR-BONATE (MG/L CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)	SODIUM AD-SORP-TION RATIO	POTAS-SIUM, DIS-SOLVED (MG/L AS K)	BICAR-BONATE (MG/L AS HCO3)	CAR-BONATE (MG/L AS CO3)	SULFATE DIS-SOLVED (MG/L AS SO4)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	SILICA, DIS-SOLVED (MG/L AS SIO2)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)
OCT 29...	1247	9.3	448	20.0	92	34	24	7.8	43	2.0	4.7	71	0	51	63	.2	15	244
DEC 17...	1627	21	563	6.0	130	82	34	12	54	2.0	5.1	64	0	76	94	.2	15	322
JAN 21...	1450	544	279	9.0	88	23	26	5.7	18	.8	5.0	80	0	24	27	.2	5.3	151
MAR 04...	1330	28	572	6.5	150	84	39	12	49	1.8	4.3	76	0	90	81	.1	12	325
MAY 27...	1610	28	542	29.0	150	78	39	12	50	1.8	5.0	84	0	71	77	.4	16	312
JUL 07...	1900	5.1	572	31.0	140	63	37	11	59	2.2	4.8	91	0	67	90	.2	13	327
AUG 21...	0807	1.4	735	27.5	160	71	43	13	81	2.8	4.0	110	0	99	110	.2	13	417

Station 08110325 - Navasota River Above Groesbeck

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS)	SPE-CIFIC CON-DUCT-ANCE (MICRO-MHOS)	PH FIELD (UNITS)	TEMPER-ATURE, WATER (DEG C)	HARD-NESS (MG/L AS CACO3)	HARD-NESS, NONCAR-BONATE (MG/L CACO3)	CALCIUM DIS-SOLVED (MG/L AS CA)	MAGNE-SIUM, DIS-SOLVED (MG/L AS MG)	SODIUM, DIS-SOLVED (MG/L AS NA)	SODIUM AD-SORP-TION RATIO	POTAS-SIUM, DIS-SOLVED (MG/L AS K)	BICAR-BONATE (MG/L AS HCO3)	CAR-BONATE (MG/L AS CO3)	SULFATE DIS-SOLVED (MG/L AS SO4)	CHLO-RIDE, DIS-SOLVED (MG/L AS CL)	FLUO-RIDE, DIS-SOLVED (MG/L AS F)	SILICA, DIS-SOLVED (MG/L AS SIO2)	SOLIDS, SUM OF CONSTI-TUENTS, DIS-SOLVED (MG/L)
OCT 29...	1630	.54	427	7.8	19.5	190	8	70	3.4	16	.5	3.2	220	0	8.4	23	.1	15	248
DEC 18...	1300	18	401	--	6.5	130	8	46	4.0	26	1.0	4.4	150	0	7.2	47	.2	5.6	214
JAN 22...	1705	834	253	--	9.0	97	7	34	3.0	11	.5	5.1	110	0	13	16	.2	5.8	142
MAR 05...	1015	360	297	--	6.0	130	12	46	2.8	11	.4	3.7	140	0	13	12	.3	8.8	167
APR 15...	1515	503	285	--	17.5	100	10	35	3.1	14	.6	4.2	110	0	22	17	.2	4.4	154
MAY 28...	0940	10	233	7.6	26.0	100	1	36	2.4	6.3	.3	3.6	120	0	5.3	7.1	.3	14	134
JUL 08...	0940	.03	449	--	--	210	10	80	3.6	10	.3	2.3	250	0	9.8	17	.2	3.2	249

Table 6-13. Water quality data from four (4) stations in the TOSES project area (water year October 1979 to 1980) (USGS 1980) - continued.

Station 08109500 - Brazos River Near College Station

DATE	TIME	STREAM-FLOW, INSTANTANEOUS (CFS)	SPECIFIC CONDUCTANCE (MICROMHOS)	PH FIELD (UNITS)	TEMPERATURE, WATER (DEG C)	HARDNESS (MG/L AS CACO3)	HARDNESS, NONCARBONATE (MG/L CACO3)	CALCIUM DISSOLVED (MG/L AS CA)	MAGNESIUM, DISSOLVED (MG/L AS MG)	SODIUM, DISSOLVED (MG/L AS NA)	SODIUM ADSORPTION RATIO	POTASSIUM, DISSOLVED (MG/L AS K)	BICARBONATE (MG/L AS HCO3)	CARBONATE (MG/L AS CO3)	SULFATE DISSOLVED (MG/L AS SO4)	CHLORIDE, DISSOLVED (MG/L AS CL)	FLUORIDE, DISSOLVED (MG/L AS F)	SILICA, DISSOLVED (MG/L AS SIO2)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L)
OCT 31...	1435	691	917	8.0	21.0	250	57	72	16	93	2.6	4.7	230	0	90	130	.1	6.7	526
NOV 27...	1630	1280	1100	--	17.0	280	87	79	19	120	3.1	5.5	230	0	110	180	.4	5.5	633
DEC 31...	1840	4750	786	--	10.5	210	76	65	11	84	2.5	5.2	160	0	86	120	.3	8.6	459
FEB 22...	0715	1280	637	--	15.5	220	57	72	9.9	45	1.3	4.0	200	0	76	54	.4	9.8	370
MAR 31...	1655	3790	524	--	19.0	170	51	57	7.6	38	1.3	5.2	150	0	61	45	.6	9.8	298
APR 30...	1925	2500	412	--	22.0	150	34	50	5.9	25	.9	4.1	140	0	48	25	.3	8.2	236
MAY 19...	1938	17600	336	--	23.5	130	18	46	4.4	14	.5	4.5	140	0	28	18	.4	13	197
JUL 31...	1955	921	908	--	32.0	230	66	64	17	95	2.7	4.4	200	0	81	150	.3	7.3	518
SEP 23...	0711	914	1310	--	27.5	250	120	70	18	170	4.7	6.1	160	0	110	280	.4	7.1	740

Station 08098290 - Brazos River Near Highbank

DATE	TIME	STREAM-FLOW, INSTANTANEOUS (CFS)	SPECIFIC CONDUCTANCE (MICROMHOS)	PH FIELD (UNITS)	TEMPERATURE, WATER (DEG C)	TURBIDITY (NTU)	OXYGEN, DISSOLVED (MG/L)	OXYGEN DISSOLVED (PERCENT SATURATION)	OXYGEN DEMAND, BIOCHEM UNINHIB 5 DAY (MG/L)	COLIFORM, FECAL, 0.7 UM-MF (COLS./100 ML)	STREPTOCOCCI FECAL, KF AGAR (COLS. PER 100 ML)	HARDNESS (MG/L AS CACO3)	HARDNESS, NONCARBONATE (MG/L CACO3)	CALCIUM DISSOLVED (MG/L AS CA)	MAGNESIUM, DISSOLVED (MG/L AS MG)	SODIUM, DISSOLVED (MG/L AS NA)	SODIUM ADSORPTION RATIO	POTASSIUM, DISSOLVED (MG/L AS K)	BICARBONATE (MG/L AS HCO3)	CARBONATE (MG/L AS CO3)	SULFATE DISSOLVED (MG/L AS SO4)	CHLORIDE, DISSOLVED (MG/L AS CL)
OCT 16...	1410	543	1100	7.4	23.0	140	7.0	82	.5	9000	1600	230	120	68	15	130	3.7	5.5	140	0	110	190
NOV 13...	1400	220	1280	7.8	13.5	1.1	14.1	134	1.0	K1	K1	270	89	80	17	130	3.4	4.5	220	0	110	190
DEC 18...	1125	1550	1290	7.6	5.0	10	12.9	100	1.0	50	20	260	140	76	17	160	4.3	5.7	150	0	120	240
JAN 22...	1015	2610	1190	7.7	10.5	37	10.2	92	1.4	4500	5000	250	140	74	17	150	4.1	5.6	140	0	120	240
FEB 20...	1000	543	569	7.4	12.5	28	11.6	109	1.4	K14	20	200	51	68	7.1	40	1.2	--	180	0	63	48
MAR 13...	1100	242	778	7.6	16.0	20	9.6	97	1.6	K11	33	230	59	71	13	77	2.2	4.1	210	0	100	79
APR 09...	1500	552	607	7.8	22.0	22	10.7	123	1.0	K16	K7	210	42	69	8.2	43	1.3	3.6	200	0	69	46
MAY 14...	1200	7150	282	7.2	20.0	1000	6.5	72	4.4	31000	35000	110	23	41	3.0	12	.5	5.0	100	0	23	22
JUN 12...	1430	231	725	7.8	29.0	3.2	10.6	138	1.2	59	66	220	220	70	10	61	1.8	4.0	200	0	75	78
JUL 09...	1320	1610	1300	7.6	--	24	6.9	92	1.2	63	21	240	130	70	17	160	4.5	5.6	140	0	120	260
AUG 14...	1400	673	1340	8.0	30.5	3.0	.8	111	.4	--	--	260	140	71	19	160	4.4	7.4	150	0	120	260
SEP 09...	1405	421	1290	7.5	28.0	3.5	7.0	89	.9	20	400	250	130	72	18	170	4.6	6.6	150	0	120	280

Table 6-13. Water quality data from four (4) stations in the TOSES project area (water year 1979 to 1980) (USGS 1980) - concluded.

Station 08098290 - Brazos River Near Highbank (continued)

DATE	FLUORIDE, DISSOLVED (MG/L AS F)	SILICA, DISSOLVED (MG/L AS SIO2)	SOLIDS, RESIDUE AT 180 DEG. C DISSOLVED (MG/L)	SOLIDS, SUM OF CONSTITUENTS, DISSOLVED (MG/L)	NITROGEN, NO2+NO3 TOTAL (MG/L AS N)	NITROGEN, NO2+NO3 DISSOLVED (MG/L AS N)	NITROGEN, AMMONIA TOTAL (MG/L AS N)	NITROGEN, AMMONIA DISSOLVED (MG/L AS N)	NITROGEN, ORGANIC TOTAL (MG/L AS N)	NITROGEN, ORGANIC DISSOLVED (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC TOTAL (MG/L AS N)	NITROGEN, AMMONIA + ORGANIC DIS. (MG/L AS N)	PHOSPHORUS, TOTAL (MG/L AS P)	PHOSPHORUS, DISSOLVED (MG/L AS P)	CARBON, ORGANIC TOTAL (MG/L AS C)	CARBON, ORGANIC DISSOLVED (MG/L AS C)	CARBON, ORGANIC SUSPENDED (MG/L AS C)	SEDIMENT, SUSPENDED (MG/L)	SEDIMENT DISCHARGE, SUSPENDED (T/DAY)	SED. SUSP. SIEVE DIAM. % FINER THAN .062 MM
OCT 16...	.4	5.7	613	<597	.85	.63	.420	.430	.98	.43	1.4	.86	.240	.130	--	11	.1	102	150	100
NOV 13...	.4	3.3	664	645	.43	.38	.090	.050	.66	.49	.75	.54	.070	.060	7.7	--	--	27	16	57
DEC 18...	.3	5.1	718	699	.18	.18	.080	.080	2.9	1.2	3.0	1.3	.060	.060	10	--	--	34	142	94
JAN 22...	.3	4.0	687	681	.40	.18	.070	.060	.23	.33	.30	.39	.290	.290	6.3	--	--	162	1140	79
FEB 20...	.3	9.7	325	331	1.3	1.3	.200	.150	.65	.56	.85	.71	.110	.080	--	9.3	.4	24	35	95
MAR 13...	.3	1.1	441	454	1.1	1.2	.130	.130	.70	.57	.83	.70	.060	.050	5.2	--	--	26	17	31
APR 09...	.5	.3	355	342	.90	.82	.130	.180	1.5	.68	1.6	.86	.110	.060	6.2	--	--	315	469	5
MAY 14...	.3	9.1	185	128	1.8	1.7	.000	.170	--	--	--	--	--	--	23	--	--	1460	28200	87
JUN 12...	.3	8.8	419	308	.26	.28	.060	.080	1.0	.78	1.1	.86	.160	.0[illegible]0	--	7.6	.5	11	6.9	84
JUL 09...	.5	6.0	768	708	.27	.25	.090	.090	.87	1.3	.96	1.4	.160	.090	11	--	--	104	452	95
AUG 14...	.3	5.7	729	719	.29	.28	.030	.030	2.2	1.7	2.2	1.7	.190	.150	--	11	.2	16	29	99
SEP 09...	.3	5.3	773	746	.22	.16	.040	.060	1.1	.94	1.1	1.0	.200	.160	4.8	--	--	16	18	97

Station 08098290 - Brazos River Near Highbank (concluded)

DATE	TIME	ARSENIC TOTAL (UG/L AS AS)	ARSENIC SUSPENDED TOTAL (UG/L AS AS)	ARSENIC DISSOLVED (UG/L AS AS)	BARIUM, TOTAL RECOVERABLE (UG/L AS BA)	BARIUM, SUSPENDED RECOVERABLE (UG/L AS BA)	BARIUM, DISSOLVED (UG/L AS BA)	CADMIUM TOTAL RECOVERABLE (UG/L AS CD)	CADMIUM SUSPENDED RECOVERABLE (UG/L AS CD)	CADMIUM DISSOLVED (UG/L AS CD)	CHROMIUM, TOTAL RECOVERABLE (UG/L AS CR)	CHROMIUM, SUSPENDED RECOV. (UG/L AS CR)	CHROMIUM, DISSOLVED (UG/L AS CR)	COBALT, TOTAL RECOVERABLE (UG/L AS CO)	COBALT, SUSPENDED RECOVERABLE (UG/L AS CO)	COBALT, DISSOLVED (UG/L AS CO)	COPPER, TOTAL RECOVERABLE (UG/L AS CU)	COPPER, SUSPENDED RECOVERABLE (UG/L AS CU)	COPPER, DISSOLVED (UG/L AS CU)	IRON, TOTAL RECOVERABLE (UG/L AS FE)	IRON, SUSPENDED RECOVERABLE (UG/L AS FE)	IRON, DISSOLVED (UG/L AS FE)
OCT 16...	1410	3	1	2	400	300	100	1	0	<1	0	0	0	3	0	<3	10	8	2	5900	5900	20
NOV 13...	1400	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
FEB 20...	1000	--	--	--	200	100	70	1	0	<1	0	0	0	3	0	<3	14	13	1	470	460	<10
MAR 13...	1100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
JUN 12...	1430	4	0	4	100	10	90	0	--	<1	20	20	0	0	--	<3	4	3	1	110	--	<10
JUL 09...	1320	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
AUG 14...	1400	2	0	3	100	0	100	1	--	<1	0	0	0	0	--	<3	10	10	0	230	--	<10

There are no outstanding permits, certified filings, or claims of surface water rights in any of the proposed mining areas on Duck Creek or any of its tributaries in the immediate vicinity of the TOSES project site. The major current consumptive use of surface waters in the project area is for livestock and wildlife. However, downstream from the Twin Oak project site on the Navasota River, five claims for water rights totaling 1,051 acre-feet per year exist for irrigation purposes.

Water consumption (forced evaporation) by the Twin Oak generating station operating at 70% annual load capacity is estimated at 10,200 acre-feet per year. Additionally, miscellaneous uses of water will require 3,200 acre-feet, giving a total annual consumptive use of 13,400 acre-feet. Make-up water from the Navasota River in a given year will be about 22,000 acre-feet. Average need will be about 7,000 acre-feet per year from Lake Limestone (TUSI 1980).

6.3.2 Environmental Consequences From the No Action Alternative

Rates and volumes of stormwater runoff can be altered by changes in land cover characteristics (i.e., soil type, slope, and relative porosity of the surface), changes in rainfall intensity, and changes in the contributing area of the drainage basin. If the no action alternative is implemented, the surface water hydrology of Duck Creek is anticipated to remain as described in Section 6.3.1. However, the Twin Oak dam is complete, and the reservoir is filling. Therefore, some changes in the hydrology of Duck Creek have already occurred. Clearing associated with construction activities for the dam, and power plant, railroad spur, and pipeline have already increased sediment deposition into Duck Creek proper.

The water quality on the Twin Oak project site (Duck Creek) should remain as described in Section 6.3.1. Because there are no large industrial or commercial developments planned for the project site (with the exception of the proposed TOSES), large point source discharges of pollutants into Duck Creek are not anticipated.

Since additional water consuming developments are not anticipated beyond those for which water in Lake Limestone has been allocated, no additional demands or changes in water supplies, proposed use, and water rights will occur due to the no action alternative. However, if the no action alternative is implemented, additional water will be available to other existing or planned developments.

6.3.3 Environmental Consequences From the Construction and Operation of the Proposed Projects

6.3.3.1 TOSES and Associated Facilities

Hydrology. Plant construction activities will alter the topography and land surface characteristics on the project site. Specifically, the area in the Duck Creek watershed will be affected by alterations in the direction and intensity of stormwater runoff. With construction of the power plant and associated facilities, the percent of impervious cover will increase. This change in land cover will result in an increase in the quantity of runoff from rainfall, however, the increase in quantity is not expected to be significant.

Water Quality. The surface waters that will be affected by the construction and operation on the TOSES project site include Duck Creek and Lake Limestone (Navasota River). During site preparation and plant construction the most probable effects on water quality will be increased sediment loading resulting from localized erosion of disturbed soil and dredging. Disruptions of the soil also will be caused by tree removal, grubbing, excavation, and grading activities. Disturbed, exposed soil is easily eroded by wind and especially by precipitation. If uncontrolled, sediment transport by runoff will temporarily degrade receiving waters by increasing levels of turbidity, oxygen-demanding materials, nutrients, and potentially toxic substances. The quantity of sediment and dissolved constituents transported downstream during construction will depend on the amount and intensity of rainfall. To reduce the sediment loading to receiving streams during construction, runoff will be contained in sedimentation ponds prior to release, and areas denuded of vegetation will be revegetated promptly.

Water Supplies, Uses, and Rights. Surface water usage and water rights are not being adversely affected by the proposed project, since the project is utilizing water according to allocations and within limitations and constraints established by the BRA and the TDWR.

Impacts from withdrawals of water from Lake Limestone were considered by the Texas Water Rights Commission (TWRC) during their environmental review prior to authorizing development of Lake Limestone and the TOSES. The TWRC allocates water for municipal, agricultural, and industrial usage to assure protection of downstream water rights and future domestic needs. The average annual withdrawal from Lake Limestone for Twin Oak Reservoir will be 6,958 acre-feet, 12% of the quantity (59,150 acre-feet) available.

6.3.3.2 Transport Systems

Hydrology. No significant impacts to hydrologic characteristics of surface waters are associated with the transport systems.

Water Quality. Construction of the proposed transport facilities will result in short-term adverse effects to most surface water resources in the project area, as well as some outside the project area. The primary impacts will occur due to clearing, digging, or grading associated with right-of-way clearance and facility construction. The most evident effects will occur where the rights-of-way cross streams or lakes. Short-term increases in turbidity are likely during periods of moderate to high rainfall. If revegetation and sedimentation ponds are effective, some of the adverse effects from erosion will be minimized.

If construction of the transport systems occurs in streams below their headwaters or in the adjacent wetlands, then a Section 404 permit as authorized by the Clean Water Act (86 Stat. 816; 33 USC 1344) will be required. Additionally, if the transport systems cross a designated navigable waterway they would be subject to Section 10 requirements pursuant to the River and Harbors Act of 3 March 1899 (30 Stat. 1151; 33 USC 403). The US Army Corps of Engineers (COE) authorizes the permits associated with both acts. By letter dated 15 July 1981, the COE stated that the Twin Oak Station and surface lignite mine *appeared* to be authorized under a nationwide general permit. Whether this will include the transport systems is presently unclear.

Water Supplies, Uses, and Rights. Construction and operation of transportation facilities will not affect water supplies, uses, and rights.

6.3.3.3 Mine

Hydrology. Because the details of mining reclamation plans and surface water control programs are limited, specific conclusions about potential impacts are not possible. However, given conceptual plans now available, the following effects can be expected. Primary impact to surface water hydrology from mining will include local alteration in the direction and intensity of surface water flows on and adjacent to the mine sites. Surface water bodies that drain the mine sites are Steele Creek, South Walnut Creek, and the Navasota River, a main tributary of the Brazos River.

During active mining, natural surface drainage patterns will be disrupted, resulting in a significant alteration in the routing of surface flows. Streams in the mine area that will be altered during mining operations include Steele Creek and its tributaries (Davis Creek, Cox Creek, Owen Creek, and Willow Creek) and South Walnut Creek. These streams will be temporarily relocated through use of dikes and diversion channels, conforming to regulations imposed by the Texas Surface Mining Control and Reclamation Act. Mining and reclamation activities in the project area will have an impact on baseflow conditions of these creeks. During mining, an increased, and perhaps more steady, flow regime likely will be maintained during otherwise low-flow periods due to the runoff control structures and mine dewatering operations. Since the unconfined aquifer contributing flow to the creeks will be reduced in major areas of the contributing watersheds, it is expected that over the long-term mining will alter the hydrologic regime of these creeks, especially during low-flow conditions.

Due to the altered topography, each mine pit will temporarily change surface drainage patterns. As a result, a combination of runoff entrapment in mine pits and altered surface flow routing will occur.

The mean velocity of overland flow is inversely related to the hydraulic resistance of the surface. In other words, the more irregular the surface, the slower the flow. The velocity of overland flow on rough surface conditions often is only one-sixth of that on bare soil. Rough surface soils allow much more time for infiltration after rainfall stops, resulting in less runoff from a basin.

Effects of mining on the surface drainage patterns of the watersheds or subwatersheds in the project area are partly based on the final configuration of the reclaimed land surface and the overall success of the reclamation effort. It is possible that local changes in the direction of drainage in Steele Creek could occur as a result of regrading the mined lands; however, such alterations are not expected to be significant.

Successful reclamation/revegetation may result in infiltration capacities of reclaimed land higher than those of the present land surface. The breaking up of consolidated layers during draglining, bulldozing, dumping, and mixing of topsoils could result in the surface of the reclaimed land having a higher permeability than before mining. Therefore, runoff and downstream flows of affected surface waters may decrease. However, the reestablishment and maintenance of vegetation following mining directly influences the post-mining infiltration rates and surface water runoff characteristics.

Water Quality. The most common surface water pollutants typically associated with surface lignite mining in Texas are TSS, iron, and acid leachates. During site preparation and mining, erosion of exposed soil will occur and surface runoff may transport sediments into nearby streams and cause an increase in turbidity. To reduce impacts from sedimentation, surface water runoff will be routed around areas of exposed soil. Less than 200 acres of soil surface will be exposed during any one period of time and slopes of construction excavations and fills will be contoured to 18 degrees and revegetated to protect exposed areas from wind and water.

Some erosion of topsoil may take place between removal and the time it is adequately protected by vegetative cover. However, the greatest potential for erosion is through valleys between spoil piles. The nature of overburden materials, their unconsolidation during excavation, and their placement in steeply graded piles render these materials highly erodable. The erosion potential varies seasonally; the spring and summer storm season is the period of greatest concern. Multiple retention and treatment ponds as well as timely reclamation will be used to control adverse effects on downstream water quality. If clay soil is used as a liner, TDWR will require a coefficient of permeability of 1×10^{-7} cm/sec.

Another common surface water pollutant associated with surface mining activities is acid leachate. Two potential sources of acid leachate are (1) contaminated groundwater that seeps directly into creeks; and (2) direct surface runoff that carries acid materials from refuse piles into receiving streams. To mitigate potential impacts from such leachates, surface runoff that contacts mined areas and refuse spoil piles will be routed to retention and treatment ponds so that potential acid materials do not reach receiving streams. This is important because mine spoil piles consist of shales, clays, and low-grade lignites that contain pyrite. When pyrite is exposed to moisture and oxygen, it is chemically oxidized to produce acid mine wastes of sulfates, ferrous iron, and sulfuric acid. When precipitation falls on the refuse piles, the acid materials and sediments can be washed into receiving streams. However, seepage, surface water runoff, and rainwater will be controlled in the pit by a series of collection and drainage ditches, and sumps. As part of the TRC surface mining permit, the applicant will be required to develop detailed plans for handling acid-forming materials and for controlling, treating, and disposing of surface water runoff that potentially could contact these substances.

Mine haul roads may be as large as 60 feet or more in width with a ditch and a berm. They are high-standard roads, compacted and made of dense material to sustain a traffic load of more than 200 tons. Since stormwater runoff will increase from these impermeable areas created by the mine roads, runoff from the berms, which are not normally compacted, will constitute an additional source of sediment loading to local streams. Secondarily, fugitive dust from mining roads will settle on vegetation and soil adjacent to stream channels and eventually will be washed into streams by precipitation. Sediment loadings generated by this washing process are usually insignificant.

Detailed programs for monitoring surface water effects due to mining and reclamation activities have not been established by the permit applicant; however, the applicant does intend to establish and implement a sampling program during the operational phase of mining.

Water Supplies, Uses, and Rights. Water requirements for mining include water for dust control, both in the active mining areas and on roads, and possibly for use during reclamation. Water for dust control at a 25,000 tons per day lignite strip mine is estimated at approximately 500 acre-feet per year. By contrast, land reclamation and revegetation of a strip-mined area could require as much as 2 acre-feet of water per day (irrigation plus rainfall) per acre of land surface mined and reclaimed (Hoffman 1978). Thus, for a 20,000 ton per day mine, with a mining rate of 9,000 tons per acre, the total water requirement is approximately 2,000 acre-feet per year (approximately 1,500 acre-feet per year for land reclamation and revegetation). Rainfall is an extremely important factor in determining the quantity of water actually needed. However, the applicant does not plan to irrigate. Past experience by the applicant on their Big Brown power plant located in Freestone County revealed that no water for land reclamation and revegetation was required due to the sufficient precipitation in East Texas. As part of a normal mining operation, water can be pumped from the mine pits and sprayed by trucks on roads and mining areas for dust control. No significant impact is anticipated on water use, water supply, or water rights due to the mining activities.

6.4 AIR QUALITY

6.4.1 Existing Conditions

Climate/meteorology, applicable air quality regulations, and ambient air quality are discussed in this section. The meteorological information is necessary for modeling the dispersion of the air pollutants generated by TOSES. The applicable standards and permits that TUSI must follow and the existing ambient air quality (prior to the construction of TOSES) are also described.

6.4.1.1 Climate/Meteorology

A meteorological monitoring program was conducted by TUSI at the TOSES site during 1974. This program confirmed the assumption that the climatological data for Waco, Texas were applicable to the TOSES site. Thus, some of the climatic data presented were obtained from the Waco monitoring station. The major climatological factors affecting the dispersion of pollutants in the project area are temperature, precipitation, evaporation, wind speed and direction, and atmospheric stability.

Temperature. The annual average temperature range in Waco varies from a daily maximum of 77.8°F to a daily minimum of 56.4°F. A continental type climate characterized by extreme variations in temperature is typical for the project area. From a period beginning in 1941, the highest recorded temperature (112°F) occurred in August of 1969 and the lowest recorded temperature (-5°F) was recorded in January 1949 (USDOC/NOAA 1980).

Precipitation. Total annual rainfall at Waco has ranged from 13.3 inches in 1917 to 60.2 inches in 1905. The annual average precipitation is 33.5 inches, with the highest amount of rainfall occurring during April and May and the least amount of rainfall occurring during July and August.

Acid precipitation is a suspected but undocumented problem associated with operation of coal-fired power plants. The acidity of a substance is measured in pH units. Unpolluted rain is assumed to have a pH between 5.6 and 5.7, therefore, the term "acid rain" has come to mean rainfall with a pH of less than 5.6. There are three monitoring sites for acid precipitation in East Texas established by the Texas Air Control Board (TACB) and one monitoring site established by the World Meteorological Organization. These sites are in Tyler, Beaumont, Fort Worth, and Victoria and are approximately 104 miles, 161 miles, 115 miles, and 172 miles from the TOSES project site, respectively. The Tyler and Beaumont monitoring sites were established by the TACB in 1979, while the Fort Worth site was set up by the TACB in 1980. The Victoria site was established by the World Meteorological Organization in 1972. The latest year that TACB has received data for the Victoria site is 1976. Data for the four sites in East Texas are presented in Table 6-14. Acid precipitation from power plants in Texas is not a documented phenomenon.

Table 6-14. Recorded pH ranges for rainfall from four towns in Texas.

Location	Year	Low	High	Mean	Number of Samples
Tyler[1]	1979	4.1	5.8	4.8	9
Tyler[2]	1980	3.5	4.8	4.2	23
Beaumont[1]	1979	4.3	6.6	5.6	7
Beaumont[2]	1980	3.6	7.5	4.6	11
Fort Worth[2]	1980	4.7	6.6	5.4	11
Victoria[1]	1976	N/A	N/A	5.2	N/A

N/A - Not Available

Source: (1) Texas Air Control Board. 1980. Measurement of precipitation pH in Texas by the TACB. Austin TX, 16 p.

(2) Porter, Thomas H., Ph.D. 1982. Phone, Thomas Porter, Ph.D., Texas Air Control Board, to Dawn Davenport-Johnson, WAPORA, Inc., 21 January 1982.

Evaporation. Monitoring data for evaporation comes from the Weather Bureau monitoring station at Belton Dam approximately 75 miles west of the TOSES project site. The annual average evaporation was 79.03 inches for the years 1951 through 1960 (USDOC 1965).

The precipitation-evaporation (P-E) index, developed by C. Warren Thornwaite, is an analysis which considers humidity, precipitation, and temperature in developing a numerical value to describe the moisture into (precipitation) and out of (evaporation) an area. Lower fugitive emissions from coal storage piles and other cleared or exposed surfaces are associated with higher P-E index values. This results because higher P-E index values are indicative of higher precipitation and lower evaporation. This value would apply to the fugitive emissions from both the power plant and mine. The P-E index value for Robertson County and Limestone County are 87 and 62, respectively. These values are less than the national average of 91 (USEPA 1978b). However, the P-E Index can be somewhat misleading in certain situations because it does account for all factors affecting fugitive dust emissions. Some of the factors include (1) moisture content of the coal (approximately 33%), (2) particle size of the coal (approximately 6 inches in diameter), and the effectiveness of the various control devices utilized in the power plant and mine such as water sprays, covered conveyors, enclosures, and dynamic wet scrubbers.

Wind. The average wind speed in the project area is 11.5 mph. A wind rose for the project area is shown in Figure 6-11. The prevailing winds are from the south (USDOC/NOAA 1980; TUSI 1980).

Atmospheric Stability. Mixing layer height, a meteorological parameter that is important in the determination of air quality, is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Interpolated mixing heights for the project area are shown in Table 6-15.

Atmospheric temperature inversions result from the air near the earth being cooler than the air above. Inversion conditions can be caused by a number of factors and result in a stable atmosphere thereby reducing the mixing layer

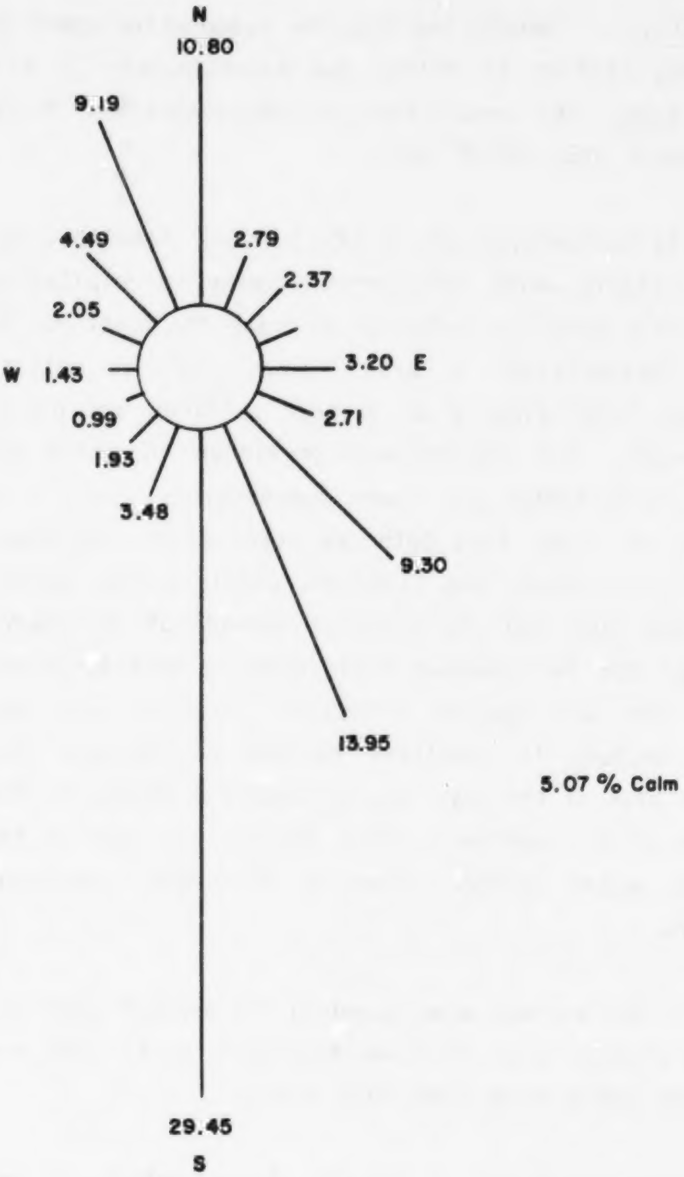

Figure 6-11. Annual wind rose for Waco, Texas (1969-1973).

Source: TUSI 1980. Environmental Information Document for TOSES. Prepared for USEPA, Region 6, Dallas, TX, variously paged.

height. However, the power plant plume should nonetheless penetrate the 500 foot inversion level under all situations and not result in dramatically increased ground level concentrations. Data relating the percent of time there is an atmospheric inversions prevail in the project area are presented in Table 6-16.

Maximum concentrations of air pollutants often occur at ground level during periods of high-pressure stagnation. During the period from 1936 through 1975, Waco recorded three stagnation episodes (periods lasting at least 4 days), with a total of 14 days of stagnation.

6.4.1.2 Applicable Regulations

There are two air quality criteria which a facility such as TOSES must meet when locating in an area where the existing air is cleaner than the National Ambient Air Quality Standards (NAAQS). The facility can neither cause the air quality to deteriorate to a level which would violate the NAAQS, nor can it exceed the applicable PSD increment.

The NAAQS were established by Congress for the protection of health and welfare. Under these standards the levels of air pollution acceptable for health and welfare were set by primary and secondary standards, respectively. Pollutants for which these standards have been set are referred to as "criteria pollutants." The criteria pollutants and their primary and secondary standards are presented in Table 6-17.

PSD areas are regions where the existing air quality is cleaner than the NAAQS. In these areas, Congress has determined that additional pollutant growth will be limited to a certain increment. In addition, three classes of areas were identified with different increments assigned to each class. Class I areas are pristine areas where any effects from air pollutants may be adverse. Class II areas are regions of nominal air quality sensitivity. Class III areas have little air quality sensitivity and the air quality increment for these areas is most lenient. At present only two pollutants (particulate matter and sulfur dioxide) have been assigned PSD increments. The increments allowed for each of the PSD classes are presented in Table 6-18. Class I areas are scattered throughout the US, while the remaining

Table 6-15. Interpolated mean mixing layer heights (ft) for the project area.

Season	Morning Mixing Heights (ft)	Afternoon Mixing Heights (ft)
Winter	1,600	3,300
Spring	2,300	4,600
Summer	2,200	6,200
Autumn	1,800	4,900
Annual	1,800	4,900

Source: Holzworth, George C. 1972. Mixing heights, wind speeds, and potential for urban air pollution throughout the contiguous US. US Environmental Protection Agency, Research Triangle Park NC, 117 p.

Table 6-16. Percent of time there is an atmospheric temperature inversion in the project area (base of inversion is $\leq$ 500 feet above the station elevation).

Season	Percentage of Time
Winter	35%
Spring	22%
Summer	17%
Autumn	35%
Annual	26%

Source: Hosler, Charles R. 1961. Low level inversions. Monthly Weather Review 89:319-339.

Table 6-17. National primary and secondary ambient air quality standards.

Pollutant	Type of Standard	Averaging Time	Frequency Parameter	Concentration	
				ug/m^3	ppm
Sulfur Oxides (as sulfur dioxide)	Primary	24 hr	Annual maximum[a]	365	0.14
		1 yr	Arithmetic mean	80	0.03
	Secondary	3 hr	Annual maximum[a]	1,300	0.50
Particulate Matter	Primary	24 hr	Annual maximum[a]	260	—
		24 hr	Annual geometric mean	75	—
	Secondary	24 hr	Annual maximum[a]	150	—
		24 hr	Annual geometric mean	60[b]	—
Carbon Monoxide	Primary and Secondary	1 hr	Annual maximum[a]	40,000	35.00
		8 hr	Annual maximum[a]	10,000	9.00
Ozone	Primary and Secondary	1 hr	Annual maximum[a]	235	0.12
Hydrocarbons (nonmethane)	Primary and Secondary	3 hr (6 to 9 A.M.)	Annual maximum[a]	160[c]	0.24[c]
Nitrogen Dioxide	Primary and Secondary	1 yr	Arithmetic mean	100	0.05
Lead	Primary and Secondary	3 mo	Arithmetic mean	1.5	—

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[a] Not to be exceeded more than once per year.

[b] As a guide to be used in assessing implementation plans for achieving the annual maximum 24-hour standard.

[c] As a guide in devising implementation plans for achieving oxidant standards.

Source: US Environmental Protection Agency. 1981d. National primary and secondary ambient air quality standards. 40 CFR Part 50, pp.531-582.

Table 6-18. Prevention of significant deterioration (PSD) increment: maximum allowable increase by class.*

Pollutant	Class I (ug/m^3)	Class II (ug/m^3)	Class III (ug/m^3)
Particulate Matter:			
Annual geometric mean	5	19	37
24-hour maximum	10	37	75
Sulfur Dioxide:			
Annual arithmetic mean	2	20	40
24-hour maximum	5	91	182
3-hour maximum	25	512	700

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*For any period other than the annual, the applicable maximum allowable increase may be exceeded during one such period per year at any one location.

Source: US Environmental Protection Agency. 1981c. Approval and promulgation plans. 40 CFR Part 52.21, pp. 20-27.

areas are designated as Class II. As yet, no areas have been classified as Class III. The TOSES project site is located in a PSD Class II area. There are no Class I areas within 200 miles of the Twin Oak project site.

A PSD permit must be obtained for a facility locating in a PSD area before construction can begin. Texas Utilities Services, Inc. obtained their PSD permit on 22 September 1977. In granting the permit, EPA determined that the operation of TOSES: (1) would not cause the Class II air quality deterioration increments to be exceeded, (2) would not cause a violation of the NAAQS, (3) would not have an impact on the air quality of any mandatory Class I areas, and (4) would use best available control technology to control emissions of sulfur dioxide and particulate matter. The specific conditions of the permit are included in Appendix B.

TUSI has applied for and received construction permits from the TACB for the two 750 MW steam electric generators (C-3992, C-3993), the lignite handling system (C-3994), and the fly ash handling system (C-3995). The special provisions associated with these permits are included in Appendix B.

6.4.1.3 Ambient Air Quality

The ambient air quality of the project area is good and within the national and state ambient air quality standards. This is characteristic of a rural community removed from heavy industry and commerce.

Ambient air quality data collected from November 1974 to October 1975 at a rural site near Athens, Texas (located approximately 77 miles northeast of the project site) and ambient air quality data from Waco, Texas were accepted by the EPA and the TACB as adequately defining the existing ambient air quality at the plant site. The data collected at the monitoring sites are presented in Tables 6-19 and 6-20. TUSI conducted a more limited air quality monitoring program at the TOSES site in 1974. The results of this sampling (Table 6-21) also indicate that the air quality at the project site is below the applicable standards.

Table 6-19. Background air quality concentrations for TSP and SO_2 from air monitoring units operating in vicinity of Athens, Texas from November 1974 to October 1975.

POLLUTANT	SITE	AVERAGING TIME	CONCENTRATION ($\mu g/m^3$)
Total Suspended Particulates (TSP)	025	Annual geometric mean	24.6
	026		28.0
	025	24-Hour	96.0
	026		126
Sulfur Dioxide	025	Annual arithmetic mean	0.02
	026		1.8
	025	24-Hour[1]	5.6
	026		41.7
	025	3-Hour[1]	30.2
	026		228.2

The ambient air quality standards for these averaging times are specified in terms of the highest concentration occurring during a year.

Table 6-20. Ambient air concentrations measured at the Waco, Texas monitoring station[1] in 1974.

Pollutant	Averaging Period	Measured Concentrations	National Air Quality Standard	
		$\mu g/m^3$ (ppm)	Secondary	Primary
Total Suspended Particulates (TSP)	Annual[2]	51	60	70
	Maximum 24-Hour[3]	111[4]	150	260
Sulfur Dioxide	Annual[5]	2		80
	Maximum 24-Hour	2[4]		365
	Maximum 3-Hour	-[6]	1300	

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[1] Texas Air Control Board Station Number 45537007

[2] Geometric Mean

[3] Not to be exceeded more than once a year

[4] Second highest concentration

[5] Arithmetic mean

[6] Not measured

Source: TUSI. 1980. Environmental Information Document for TOSES. Prepared for EPA, Region 6, Dallas TX, variously paged.

Table 6-21. Air quality monitoring at the TOSES site in 1974.

Pollutant	Period of Measurement	Measurements High	Measurements Low	Measurements Average	Units
Particulates	1 hour	394.6	16.4	123.1	ug/m^3
	24 hours	79.8	3.2	16.8	ug/m^3
Carbon Monoxide (CO)	1 hour	2.0	0	1.1	ppm
Ozone (O_3)	1 hour	0.084	0.003	0.044	ppm
Nitric Oxide (NO)	-	0.008	0	0.0004	ppm
Oxides of Nitrogen (NO_x)	-	0.090	0	0.004	ppm
Sulfur Dioxide (SO_2)	30 minutes	0.011	0	0.0024	ppm

Source: Adapted from TUSI. 1980. Environmental Information Document for TOSES. Prepared for EPA Region 6, Dallas TX, variously paged.

There are no significant sources of SO_2 or particulates within 50 miles of the Twin Oak project site. Table 6-22 presents an inventory of all point sources and area sources within 50 miles of the project area as of December 1974. This inventory has not been updated since 1974. Sources within 50 miles of the TOSES that applied for a TACB construction permit between January 1975 and August 1977 are shown in Table 6-23. The sources for Robertson County are current as of November 1979 (TUSI 1980).

6.4.2 Environmental Consequences From the No Action Alternative

Development of the lignite resources will continue to occur in the project area regardless of whether the TOSES is permitted. Emission of particulates, sulfur dioxide (SO_2), and oxides of nitrogen (NO_x) will be associated with other developments. In the short term, the air quality will be less degraded without the TOSES, however, the anticipated development at trend in the area will eventually result in some air quality degradation. However, in the short-term without the TOSES the air quality will be less degraded. This degradation currently is unquantifiable.

6.4.3 Environmental Consequences From Construction and Operation of the Proposed Project

6.4.3.1 TOSES and Associated Facilities

As a result of burning lignite in the TOSES, substantial quantities of particulates, SO_2, and NO_x, and lesser quantitites of carbon monoxide (CO), carbon dioxide (CO_2), and hydrocarbons (HC) will be emitted. Fugitive dust also will be generated during the transportation and preparation of lignite for combustion.

The allowable emission levels of particulates, SO_2, and NO_x (Table 6-24) are included in the PSD permit and the TACB construction permit issued for the TOSES. At these levels, emissions from the TOSES will not (1) cause the Class II PSD increments to be exceeded, (2) cause a violation of the NAAQS, and (3) have an effect on the air quality of any mandatory Class I areas (Harrison 1977). The relationship of the TOSES emissions to the PSD Class II increments is shown in Table 6-25.

Table 6-22. Emission inventory for all point and area sources within 50 miles of the TOSES.

Emission Categories	Pollutant Emissions (Tons/Year)	
	Particulates	Sulfur Dioxide
1. Residential Fuel Combination		
Natural gas	61	1
Oil	15	51
Wood	219	0
Total Residential (Area Source)	295	52
2. Commercial-Industrial Fuel		
Natural Gas	28	1
Oil	71	293
Total Commercial-Industrial (Area Source)	99	294
3. Solid Waste Disposal (Area Source)	174	15
4. Industrial Processes (Point Sources)		
Food and Agriculture	1,386	2
Mining and Mineral Production	16,215	0
Petroleum and Petrochemical	73	6,405
Lumber and Wood Products	2,678	107
Primary and Fabricated Metals	21,362	47,527
Machinery	284	23
Others	2,121	1,900
Total Industrial Processes (Point Sources)	44,119	55,964
5. Total Electricity Generation (Point Sources)	13,754	90,582
6. Total Surface and Air Transportation (Area Source)	2,239	1,514
7. Miscellaneous - Area Sources (Including Fires, Agricultural Filling, etc.)	17,462	0
AREA SOURCE (TOTAL)	20,292	1,875
POINT SOURCE (TOTAL)	57,873	146,546
GRAND TOTAL EMISSIONS	78,185	148,421

Source: TUSI. 1980. Environmental Information Document for TOSES. Prepared for EPA, Region 6, Dallas TX, variously paged.

Table 6-23. Point sources within 50 miles of the TOSES that were issued permits for construction or modification by Texas Air Control Board since 1 January 1975.

County	Type of Process	Emissions (Tons/Year) Particulate	Emissions (Tons/Year) SO_2
Bell	Grain Elevator - Storage and Outloading	11.0	
Brazos	Gas Turbine - Oil and Gas Fired	4.2	8.3
	Grain Receiving Pit	0.6	
	Boiler	122.0	3442.0
	Bulk Feed Receiving and Loading Facility	5.7	
	Asphaltic Concrete Plant	22.4	
Falls	Ready Mix Concrete	5.8	
	Planters Grain	5.0	
Freestone	Aggregate Processing Plant	2.7	
	Fly Ash Separation Plant (General Portland/TUSI)	2.5	
	Triethylene Glycol Dehydrator		19.7
	Natural Gas Sweetening		1232.0
Limestone	Mushroom Spawn Growing Facility	1.0	
	Rock Crusher	41.6	
	Rock Crusher	59.8	
McLennan	Milk Processing Facility	42.3	
	Raw Material Receiving and Batch Mixing System	5.2	
	Glass Melting Furnace	20.1	
	Syrup Cooking	0.1	
	Automobile Shredder	1.3	
	Whole Grain	6.3	
	Boiler Gas/Oil Fired		37.0
	Bulk Feed Facility	3.5	
	Grainery Handling and Storage	16.8	
	Cement Stabilization Plant	5.2	
	Ready Mix Concrete Batch Plant	6.1	
Robertson	Sawdust Collection Unit	2.7	
	Central Mix Concrete Plant	8.3	
	Soil Stabilization Plant	6.8	
	Natural Gas Sweetening		1660.0
TOTAL EMISSIONS		408.6	6339.0

Source: TUSI. 1980. Environmental Information Document for TOSES. Prepared for EPA, Region 6, Dallas TX, variously paged.

Table 6-24. Emission limits specified in the PSD permit and Texas Air Control Board (TACB) construction permit.

Pollutant		Emission Limits
Particulate matter	-	0.10 pounds per million BTU heat input[a]
	-	shall not exceed 20% opacity except for one 6-minute period per hour of not more than 27% opacity[a]
	-	shall not exceed 20% opacity, except for those periods described in TACB Rule 131.03.03.001 of Regulation I (e.g., cleaning the firebox, equipment changes, ash removal)[d]
	-	shall not exceed 792 pounds per hour for each steam generator[d]
	-	emissions from the two 750 MW lignite-fired units taken together shall not exceed 1,586 pounds per hour[b]
	-	emissions from the lignite handling system shall not exceed 10 pounds per hour or 43.8 tons per year[d]
	-	emissions from the fly ash handling system shall not exceed 10 pounds per hour or 43.8 tons per year[d]
Sulfur dioxide (SO_2)	-	1.08 pound per million BTU heat input[a,d]
	-	maximum emission rates of SO_2 from the two 750 MW lignite-fired units taken together shall not exceed 17,058 pounds per hour[b]
Nitrogen dioxide (NO_2)	-	0.60 pounds per million BTU[a]
	-	4,752 pounds per hour for each steam generator (nitric oxides)[d]

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[a] US Environmental Protection Agency. 1981f. Standards of Performance for fossil fuel-fired steam generator. 40 CFR Part 60, Subpart D, pp. 206-213.

[b] Specified in the PSD permit.

[c] US Environmental Protection Agency. 1981e. Standards of performance for coal preparation plants. 40 CFR Part 60, Subpart Y, pp. 265-267.

[d] Specified in TACB construction permit.

Table 6-25. Comparison of the maximum predicted concentrations resulting from SO_2 and particulate emissions to the PSD Class II increments.

		Maximum Predicted Concentration		
Pollutant	Averaging Time	Concentration (ug/m^3)	Distance (Miles)	Allowable PSD Class II Increment (ug/m^3)
TSP	Annual Mean	1.0	7.5	19.0
	Maximum 24-Hour	6.3	3.3	37.0
SO_2	Annual Mean	3.9	7.5	20.0
	Maximum 24-Hour	69.0	3.3	91.0
	Maximum 3-Hour	505.0	3.3	512.0

Source: Radian Corporation. 1977. Letter, from J.D. Stuart, Radian Corporation, to L.F. Fikar, Texas Utilities Services, Inc., 30 August 1977, 4 p.

The TOSES will be equipped with the best available control technology (BACT) to control emissions of particulate matter, SO_2, and NO_x. These controls are described in detail in Section 5.3.1. Briefly, they include electrostatic precipitators to remove 99.75% of the ash (particulate matter) in the flue gas, and wet limestone scrubbers to achieve 71.9% removal of SO_2. These design efficiencies will achieve compliance with the permit requirements for particulates and SO_2. Control of NO_x emissions requires no additional control equipment. Controlled combustion techniques, principally staged combustion and minimization of excess air, constitute BACT for NO_x as defined by EPA. Boilers for both Twin Oak units are guaranteed by the manufacturer not to exceed New Source Performance Standards for NO_x emissions (TUSI 1980). Efficient plant operation can provide optimum combustion conditions and minimize emissions of CO and HC.

Fugitive emissions of lignite dust from lignite handling will be controlled by dust collection, dust suppression, and wind barrier systems located at all lignite transfer and unloading points, lignite receiving hoppers, active storage tripper conveyor dischargers, and crusher discharge points. Water will be sprayed on the lignite as it is being transferred through the system. Covers on outdoor conveyors and the active storage pile will minimize wind-blown lignite dust (TUSI 1980). Requirements specified in the TACB construction permit are presented in Appendix B.

Uranium an thorium are radioactive elements found in trace quantities in all coal and lignite fuels. When coal or lignite is burned, their mineral content is converted to ash and slag. These waste products contain the radionuclides originally present in the coal. A fraction of the ash is released to the atmosphere; the quantity released depends on the efficiency of the particulate control system, mineral matter content of coal, furnace design, and applicable emission control standards. There are no emission standards or proposed standards for radioactive emissions from power plants. The lignite being burned will be approximately 10% ash, of which 20% will remain as slag in the furnace. Of the 80% of ash that leaves the boiler, in excess of 99% of this quantity will be captured by control devices and will not be emitted to the atmosphere.

An average uranium content of 1.7 ppm and an average thorium content of 3.12 ppm were found in an analysis of 21 core samples from the Twin Oak Mine (Southwest Research Institute 1975). The average uranium content for all coals in the US is 1.8 ppm, while the average thorium content is 4.7 ppm (Swanson 1976). The values for coal from the Twin Oak mine are within the expected concentration range for typical coals.

EPA currently has not determined whether radiation standards are necessary for the minimal radioactive hazard associated with coal-burning facilities (by phone, Allen Richardson, USEPA, 19 January 1982). However, standards to control particulate emissions will also reduce emissions of radionuclides in excess of 99%. The TOSES has been designed to meet the New Source Performance Standard of 0.1 pound of particulate matter per million BTU of heat input.

There has been much discussion in the literature about the causes and effects of acid rain. As was discussed earlier, rain formed in clean, dust-free air has a pH between 5.6 and 5.7. As rain forms and falls, it collects other gases and particulates in the air resulting from both natural and man-made sources. Some of these materials may modify the pH of the rain.

The process by which acids are deposited through rain or snow is frequently called wet deposition. However, another atmospheric process known as dry deposition may also occur. Dry deposition is the process by which particles or gases are deposited, or adsorbed, onto surfaces. While these particles or gases normally are not in the acidic state prior to deposition, they may be converted into acids after contacting water in the form of rain, dew, fog, or mist, following deposition.

The principal materials that are believed to contribute to acid deposition are sulfur oxides and nitrogen oxides. Natural sources of these materials include volcanic activity, biological decay, and lightning. Power plants and industries that burn coal (including lignite) or oil are major sources of both sulfur oxides and nitrogen oxides. Automobiles and natural gas combustion are major sources of nitrogen oxides (TACB 1981). It should be noted that without reliable and comparable long-term historic emissions data and surface water trend data, it is very difficult to identify trends and to correlate increased emissions with changes in pH values.

The majority of oxides of sulfur and nitrogen from the TOSES will be emitted from two 450 foot stacks on the project site. These pollutants will be carried by the winds and may be deposited far from the project site. The primary area that may be affected by acid deposition would be to the north, since the direction of the prevailing wind is from the south. The long-range transport aspect of acid deposition makes it difficult to determine the location and extent of acid deposition caused by a specific source (Interagency Task Force on Acid Precipitation 1981). Currently, the Texas Energy and Natural Resources Council is conducting a regional study on acid rain and impacts from acid rain in Texas.

6.4.3.2 Transport Systems

Fugitive dust and increased vehicular emissions exist and will continue to be produced from the construction of the railroad spur, transmission lines, and pipeline. The effect of the construction activities on air quality will be minor and short-term in nature. There will be no significant effect on the air quality of the project area resulting from the operation of the railroad spur and pipeline, however there are some potential minor adverse effects associated with transmission lines. Corona is a luminous electric discharge surrounding an electrical conductor which has a voltage gradient at the surface exceeding approximately 15 KV/cm (in air). The specific design of the proposed transmission line will determine the surface voltage gradient and the level of effect. Surface irregularities such as water drops, dirt, insects, or scratches on the line could cause a corona even on those lines where the voltage gradient is below 15 KV/cm. Currently, the voltage gradients at the surface of the transmission lines for the TOSES are unknown, but are calculated to be less than 15 KV/cm.

Ozone production is a possible effect of a high voltage electric transmission line; however, ozone produced by the proposed transmission facilities is anticipated to be low and should not have any significant effect upon humans, animals, or plants.

High voltage transmission lines can produce electric and magnetic fields at ground level, potentially resulting in hair stimulation, spark discharges, and steady state AC currents in humans and animals. The field strength beneath the proposed transmission facilities is not known. A field strength of 23 KV/m is required to induce hair nerve stimulation; however, hair nerve stimulation may be perceived by some individuals standing directly beneath less intensive lines. The field strength of a 345 KV line would be less than 10 KV/m. Humans and animals which are grounded, and which touch an ungrounded object (particularly a large object such as a car or bus) while beneath transmission lines potentially could receive a shock due to a spark discharge. When touching a larger vehicle (e.g., 10 feet x 10 feet x 40 feet) adult men may receive a steady state secondary shock intense enough to be startled, but below the primary shock level. Since voltage gradients are not known, potential shocks are impossible to predict.

6.4.3.3 Mine

The major air quality effect from surface mining is caused by fugitive dust, specifically coal dust and overburden dust. Since the P-E index value for this area of Texas is slightly lower than the national average, the uncontrolled fugitive dust from the mining activities typically would be higher than the national average. The various surface mining operations which cause fugitive dust emissions can be ranked approximately in the following order of decreasing emission rates (Industrial Environmental Research Laboratory 1980):

(1) overburden removal
(2) haul roads
(3) reclamation
(4) storage
(5) shovels/loading
(6) transfer and conveying
(7) truck dumping
(8) crushing
(9) waste disposal

Specific data on emission rates for several of these mining operations are presented in Table 6-26.

The specific impact of fugitive dust on human health is generally considered minimal. Most negative health effects attributable to dust are thought to be associated with respirable size particles. The larger particles of dust emitted by the Twin Oak mine should settle rapidly, with the respirable size particulates remaining suspended longer. Prolonged inhalation of respirable

Table 6-26. Total suspended particulate emission factors for surface coal mines.

Activity	Units	Emission Factors Lowest	Average	Highest
Overburden Removal	lb/yd^3	0.003	0.021	0.053
Coal Loading	lb/ton	0.002	0.006625	0.014
Haul Roads[a]	lb/veh-mi	11.2	14.1	17.0
Spoil Piles	lb/ac/hr	1.6^u	1.6^u	1.6^u
Fly Ash Dump	lb/hr	3.9	3.9	3.9

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a - Only vehicle miles by haul trucks; travel by other vehicles on haul roads (pick-up trucks, etc.) is incorporated into these values.

u - Wind speed in meters per second.

Source: USEPA. 1978c. Survey of fugitive dust from coal mines. Washington DC, variously paged.

dust can cause negative health effects, primarily to the lungs. The effects of long-term exposure to coal and overburden dusts are not well documented for surface coal mines (Rusek 1978). Both Mine Safety and Health Administration (MSHA) and Occupational Safety and Health Administration (OSHA) monitoring will be conducted to document and prevent unhealthy working conditions due to dust. The permanent program performance standards for surface mining activities under the TRC Coal Mining Regulations require that:

> each person who conducts surface mining activities shall plan and employ fugitive dust control measures as an integral part of site preparation, coal mining, and reclamation operations. The TRC shall approve the control measures appropriate for use in planning, according to applicable Federal and State air quality standards, climate, existing air quality in the area affected by mining, and the available control technology.

The Twin Oak mine will comply with these standards. An example of the control measures that will be applied are watering of haul roads and prompt revegetation of disturbed lands.

6.5 SOUND QUALITY

6.5.1 Existing Conditions

The noise levels associated with a TOSES power plant and associated mine can affect the people in the surrounding environment. Determining existing noise levels is necessary to establish a baseline for comparing noise levels associated with the TOSES.

A survey to establish baseline noise level data for the project area was performed during July 1973. No new noise generators have located in the TOSES project site vicinity since that survey; receptors in the immediate area have decreased. Therefore, the conclusions of the 1973 survey should be conservative (TUSI 1980).

Sensitive receptors associated with places such as schools, churches, and hospitals are particularly susceptible to noise. The location of 12 sampling sites selected for their proximity to receptors and the proposed facilities are shown in Figure 6-12. Ambient noise levels at each station were measured

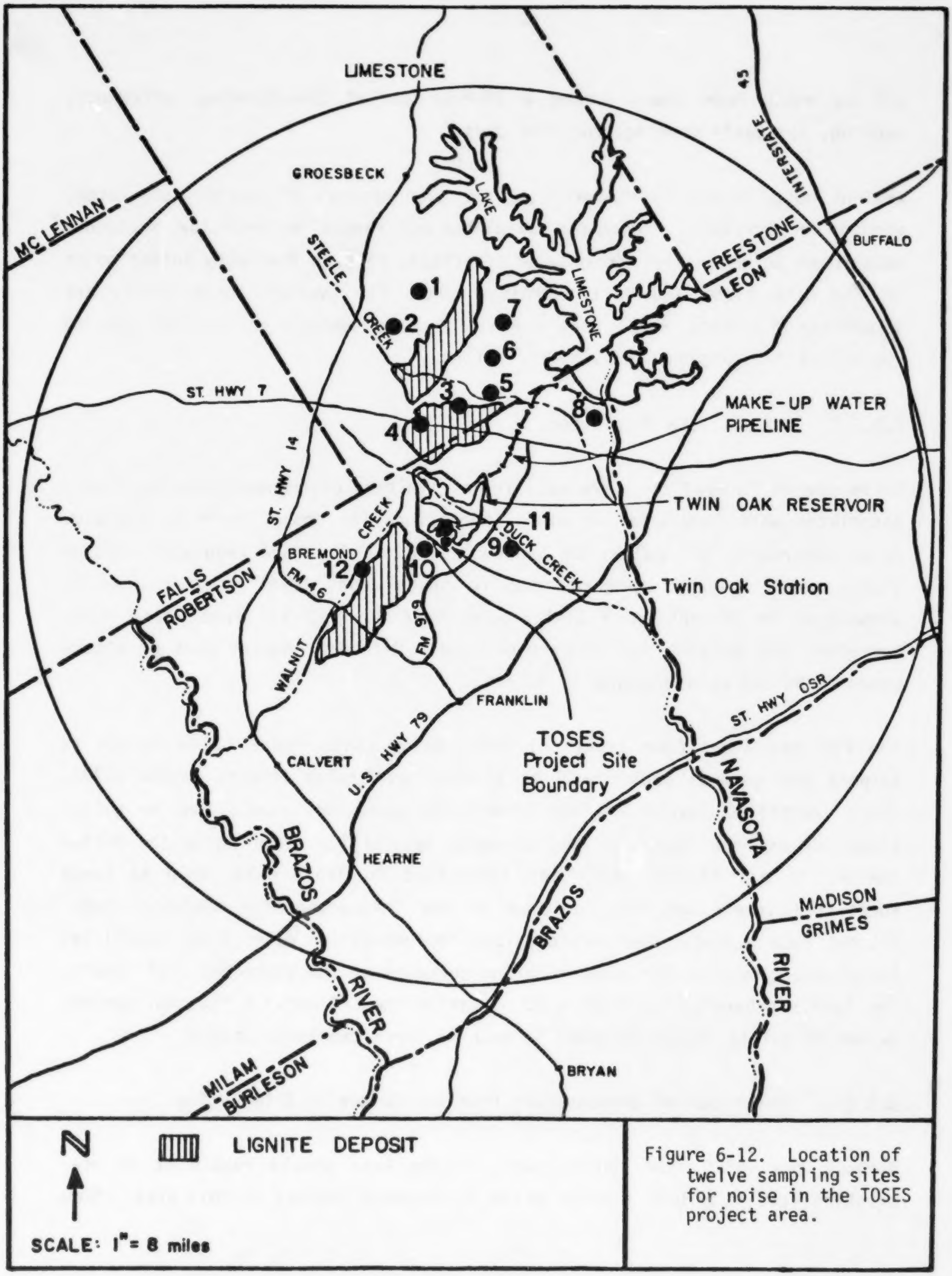
LIMESTONE
INTERSTATE 45
GROESBECK
LAKE
LIMESTONE
MC LENNAN
STEELE CREEK
FREESTONE
LEON
BUFFALO
1
2
7
6
5
3
4
8
ST. HWY 7
MAKE-UP WATER PIPELINE
ST. HWY 14
TWIN OAK RESERVOIR
CREEK
11
BREMOND
DUCK CREEK
9
12
10
Twin Oak Station
FALLS
ROBERTSON
FM 46
FM 979
WALNUT
FRANKLIN
TOSES Project Site Boundary
ST. HWY OSR
CALVERT
U.S. HWY 79
NAVASOTA
HEARNE
BRAZOS
BRAZOS
MADISON
GRIMES
RIVER
RIVER
BRYAN
MILAM
BURLESON
N
LIGNITE DEPOSIT
SCALE: 1" = 8 miles

Figure 6-12. Location of twelve sampling sites for noise in the TOSES project area.

and recorded four times during a 24-hour period (mid-morning, afternoon, evening, and early morning) for five days.

Ambient noise levels in the project area were typical of sparsely populated, wooded countryside. Predominant area noises ranged between low frequency background noise in the morning and afternoon, to high frequency insect noise in the late night and early morning. Data for overall noise levels are summarized in Table 6-27. The overall average ambient noise level for 48 representative samples was 51 decibels (dBA).

6.5.1.1 Applicable Regulations

There are no Federal or state regulations limiting environmental noise levels associated with industrial or mining operations (by phone, Jerry Lauderdale, Texas Department of Health, 29 September 1981). The OSHA regulates occupational noise. These standards require that ground level noise sources be attenuated to 90 dBA at a distance of 6 to 10 feet in areas where human receptors are present for 8 hours or more. Overhead sources must be attenuated to 85 dBA at a distance of 60 feet.

The EPA has identified levels of noise below which there is no reason to suspect the general public will be at risk from noise effects (USEPA 1978). These identified levels are not considered standards, regulations or guidelines because the technical and economic feasibility of bringing the United States, in all of the land uses identified in Table 6-28, down to these identified levels was not included in the Congressionally mandated study. Without such economic and technological implementation data, these identified leves should be used for broad planning purposes at the state and loal levels. The levels presented in Table 6-28 summarize the EPA work; a five (5) decibel margin of safety should be added to each of these tabulated levels.

6.5.2 Environmental Consequences From the No Action Alternative

Without the TOSES, the noise levels in the area should remain at or near existing levels, unless another major development locates in this area. Some

Table 6-27. Summary of noise level data (dBA) obtained from 12 sampling locations in the TOSES project area, 1973.

Site	Morning	Afternoon	Evening	Early Morning
1	51	42	58	58
2	60	54	56	55
3	45	50	59	52
4	48	56	67	67
5	41	35	57	57
6	52	46	61	55
7	53	40	55	60
8	44	40	50	57
9	37	52	53	56
10	45	44	50	56
11	38	39	47	53
12	44	43	50	55

Source: Texas Utilities Services Inc. 1980. Environmental information Document for Twin Oak Electrical Station, Robertson County, Texas, Appendix. Prepared for EPA Region 6, Dallas TX, variously paged.

Table 6-28. Yearly L_{dn} values established to protect public health and welfare with a margin of safety.

Effect	Level	Area
Hearing	$L_{eq}(24) \leq 70$ dBA	All areas (at the ear)
Outdoor activity interference and annoyance	$L_{dn} \leq 55$ dBA	Outdoors in residential areas and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
	$L_{eq}(24) \leq 55$ dBA	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor activity interference and annoyance	$L_{dn} \leq 45$ dBA	Indoor residential areas.
	$L_{eq}(24) \leq 45$ dBA	Other indoor areas with human activities such as schools, etc.

Source: USEPA. 1978a. Protective noise levels. EPA 550/9-79-100. Washington DC, variously paged.

effects have already occurred due to construction of Twin Oak Reservoir, parts of the TOSES, the rail spur, and pipeline. However, noise levels during these activities have been very localized.

6.5.3 Environmental Consequences From Construction and Operation of the Proposed Project

6.5.3.1 TOSES and Associated Facilities

Construction noise from the TOSES is expected to be characteristic of any sizable construction project. Construction will occur over a short time period and noise will result from construction activities as well as from vehicular traffic associated with construction workers. Most construction activities will take place in the plant island area which is approximately 2,000 feet within the boundary of the project site. It is expected that most construction noise levels will attenuate considerably within this distance, thereby reducing the short-term impact associated with the construction of the plant.

Operation noise will be produced principally from equipment located within the plant loop road (e.g., the boiler feed pump(s), blowing air compressor(s), forced draft and primary air fans, and induced draft fans). Additional sources will include the lignite crusher house and unloading station. The TOSES has been designed to achieve an 85 dBA level for individual pieces of equipment. An 85 dBA design criteria was used to comply with OSHA's 90 dBA standard. TUSI will utilize several methods of suppression to achieve the 85 dBA standard for noise sources at the TOSES, including acoustical lagging, silencers, and insulated housings.

The sound level resulting from the operation of the TOSES at the nearest sensitive receptor (a residence approximately 0.25 mile from the plant boundary) will be 55 to 60 dBA. For comparison, EPA's recommended noise levels are presented in Table 6-28. The 5 to 9 dBA increase over the baseline noise level of 51 dBA should have a minor to moderate effect on this receptor. This family will relocate prior to TOSES operation. Information from the National Cooperative Highway Research Manual No. 117 relating the impacts associated with various increases in noise levels is listed below:

Noise Increase	Impact
0-5	None
6-15	Moderate
16 +	Substantial

As distance from the plant increases, the noise level increase over background should diminish. The nearest receptor other than single family dwellings is over two miles from the plant. At this distance, the operational noise levels should have attenuated to background intensities.

6.5.3.2 Transport Systems

The construction of the transport facilities has and will continue to result in a short-term increase in noise levels in and near the respective rights-of-way. The corridors cross through a rural environment and therefore there will be fewer sensitive receptors will be affected. The impact will be short-term and is not expected to be significant.

There should be very little operational noise associated with the make-up water pipeline. The operation of the railroad will result in the most significant long-term noise levels and will occur through the life of the project.

Transmission lines may produce electromagnetic noise (i.e., radio and television interference). For good radio reception, electromagnetic noise from a transmission facility must not be greater than 32.5% of the field intensity of the desired radio signal. The levels of electromagnetic noise from the proposed transmission facility were not estimated. It is expected that local AM radio broadcast signals will be received at the edge of the right-of-way, but reception could potentially be affected from weak distant stations during foul weather.

Television signals may be disrupted in a manner similar to radio signals due to electromagnetic noise from transmission lines. Electric transmission lines also cause reflections and/or blockage of television signals. The levels of electromagnetic noise produced by the proposed transmission facilities were not estimated, but the reception of signals broadcast from television stations in Bryan, Waco, Dallas, and Fort Worth is expected to be below acceptable limits along the rights-of-way of the proposed transmission corridors. Specifically, since interference with television signals is greater for lower channel stations, it is anticipated that reception of Channel 3 (Bryan) will be of poorer quality than reception of Channels 6 and 10 (Temple/Waco) in the immediate vicinity of the transmission corridor. Proper selection of antenna type and location can reduce the effects of electomagnetic noise in the immediate vicinity of the proposed transmission facilities.

Audible noise produced from electric transmission lines is another result of corona. The proposed transmission lines should generate very low levels of noise during fair weather. However, audible noise potentially could reach approximately 49 dBA or greater during a heavy rain. The probability of receiving complaints of noise is low if the level is less than 52.5 dBA at a distance of 100 feet from the center of the right-of-way. No significant effects are anticipated due to audible noise resulting from the proposed transmission facilities.

Mine. The noise levels associated with mining activities are presented in Table 6-29. Assuming a 6 dBA attenuation rate for each doubling of distance away from the source, the highest noise contribution (overburden removal at 93 dBA) will attenuate to less than 60 dBA one mile from the active pit (TUSI 1981b). For comparison, EPA's recommended noise levels are presented in Table 6-28. Due to the dynamics of surface mining, receptors will change as the location of active mining changes. It is important to note, however, that residents within the mining leases move elsewhere prior to active mining. Specific information on the mine was not available, and therefore no estimates were made for the noise level increases at near-by receptors.

Table 6-29. Anticipated sound level contribution at 50 feet from the center of each mining activity.

Mining Activity	Equivalent Sound Level L_{dn} (dBA)
Ancillary Facilities Construction	84
Road Construction	82
Railroad Construction	84
Timber and Brush Removal	85
Overburden Removal	93
Lignite Mining	
Loading	75*
Handling	90
Hauling	80**
Spoil Grading and Revegetation	86

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*Includes a 15 dBA reduction for pit wall attenuation.

**Day-Night Noise Level (L_{dn}).

Source: Texas Utility Services Incorporated. 1981b. Handout at meeting with EPA and WAPORA, Inc. EPA Region 6 Offices, Dallas TX, 16 October 1981, variously paged.

6.6 BIOLOGICAL RESOURCES

6.6.1 Existing Conditions

6.6.1.1 Aquatic Communities

The major established aquatic communities in the project area include Duck Creek, Lake Limestone, the Navasota River, Steele Creek, Walnut Creek, and several unnamed tributaries and stock ponds. These communities, with the exception of Walnut Creek, are in the Navasota River drainage. Data on the existing aquatic communities currently found on the proposed project site are summarized in Table 6-30. The data summary was primarily made from data collected at 11 stations (Figure 6-13) during fall 1973 and spring 1974 (TUSI 1980).

Phytoplankton. Phytoplankton are the primary producers in the aquatic ecosystem. They are at the base of the food chain and are thus fed on by virtually all animals at higher trophic levels. Phytoplankton are dependent on sunlight, and activities that limit the transmission of light through water (e.g. sedimentation) or adversely alter water quality, affect their existence.

Of the approximately 70 taxa of phytoplankton collected in the project area in both 1973 and 1974, Diatoma sp. was the only abundant taxa (Table 6-30). Other taxa collected at most stations during fall included: Gomphonema augur, Navicula bacillum, Nitzschia filiformis, and Gonium pectoral. A diatom species and green flagellate were the only taxa collected at most of the sampling stations, while Cyclotella kutzingiana and Meliosira distans were abundant during spring 1974 collections in the Navasota River.

Zooplankton. Zooplankton densities in aquatic communities in the project area were generally high (Table 6-30). Rotifers and/or crustaceans were the dominant organisms in virtually all samples.

Densities of zooplankton from the two sampling locations on Duck Creek were unusually low. A reason for these low densities was not given (TUSI 1980).

Table 6-30. **Summary** of data collected for aquatic biota in the TOSES project area, 1973-1974.

Sampling Locations	Phytoplankton # Species 1973/1974 Abundant Taxa	Zooplankton # Per Meter³ Abundant Taxa	Macroinvertebrates 1973/1974 # Taxa Dip Nets # Sq. Yd. Benthic	Fish 1973/1974 # Per Ac-Ft. (# sp.) Numerous Species
Upper Steele Creek	50/5 Green Flagellate sp. Diatoma sp. Crucigena sp. Gonium sp.	Spring 343,040 Rotifera	18/8 48/732	1938 (5)/4877 (7) Mosquito Fish Golden Shiner
Mid Steele Creek	14/10 Diatoma sp. Crucigena sp. Nitzschia sp.	Spring 7,680 Crustacea	14/17 132/324	432 (12)/1239 (8) Mosquito Fish Ribbon Shiner Golden Shiner
Lower Steele Creek	17/10 Gonium sp. Green Flagellate sp.	Spring 5,120 Rotifera Crustacea	13/17 180/228	23,957 (10)/120 (5) Mosquito Fish Ribbon Shiner Red Shiner
Upper Duck Creek	6/11 Gonium sp. Green Flagellate sp.	0 0	13/18 204/1152	1905 (7)/688 (11) Mosquito Fish Ribbon Shiner Bluntnose Darter
Lower Duck Creek	11/13 Crucigenia sp. Green Flagellate sp. Diatoma sp.	Fall 433 Rotifera	16/12 6264/648	2581 (10)/187 (10) Ribbon Shiner Mosquito Fish
Walnut Creek	7/11 Gomphonema sp. Green Flagellate sp.	Spring 5,120 Crustacea	15/10 480/516	0 (1)/4463 (10) Mosquito Fish Bluegill White Crappie
Navasota River at SH 164	11/12 Cyclotella sp. Melosira sp. Chlorella sp.	Spring 163,840 Rotifera Crustacea	4/7 204/264	1001 (9)/786 (6) Red Shiner Gizzard Shad
Navasota River at US 7	18/9 Gonium sp. Pleurosigma sp. Melosira sp.	Spring 35,840 Rotifera Crustacea	6/9 108/24	453 (7)/179 (6) Red Shiner
Navasota River at US 79	19/10 Cyclotella sp. Melosira sp.	Spring 38,400 Crustacea Rotifera	16/15 456/36	1006 (12)/179 (6) Red Shiner Mosquito Fish Bluegill
Navasota River at OSR	NT/8 Melosira sp. Cyclotella sp.	Spring 20,480 Rotifera Protozoa	9/2 324/120	1792 (11)/811 (7) Red Shiner Bluegill Mosquito Fish White Crappie
Navasota River at Sassafras Branch	NT	Fall 96 Rotifera	8/NT 252/NT	522 (6)/NT Red Shiner Gizard Shad Largemouth Bass

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NT - No samples taken

Source: Adapted from Texas Utilities Services, Inc. 1980. Environmental information document and appendix for Twin Oak el
Robertson County, Texas. Prepared for US Environmental Protection Agency. Dallas TX, variously paged.

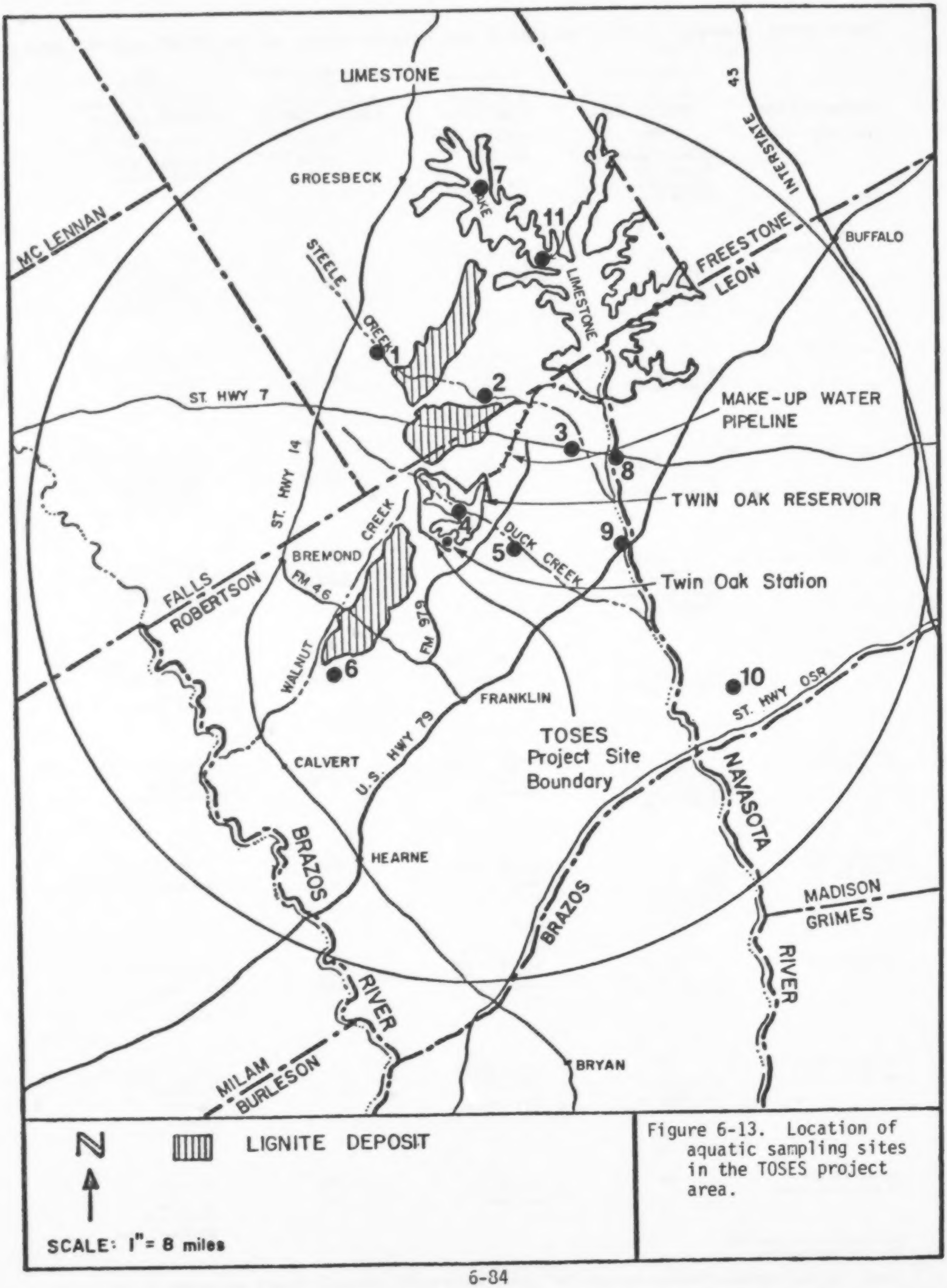

LIMESTONE
INTERSTATE 45
GROESBECK
7
LAKE
11
LIMESTONE
MC LENNAN
FREESTONE
LEON
BUFFALO
STEELE CREEK
1
2
ST. HWY 7
MAKE-UP WATER PIPELINE
3
8
ST. HWY 14
TWIN OAK RESERVOIR
CREEK
BREMOND
4
DUCK CREEK
5
9
Twin Oak Station
FALLS
ROBERTSON
FM 46
FM 979
WALNUT
6
10
ST. HWY OSR
FRANKLIN
U.S. HWY 79
TOSES Project Site Boundary
CALVERT
NAVASOTA
BRAZOS
HEARNE
BRAZOS
MADISON
GRIMES
RIVER
RIVER
MILAM
BURLESON
BRYAN
N
▥ LIGNITE DEPOSIT
SCALE: 1" = 8 miles

Figure 6-13. Location of aquatic sampling sites in the TOSES project area.

Macroinvertebrates. A high number of macroinvertebrate taxa and individuals was identified from samples in the project area (Table 6-30). Snails, crayfish, and larval stages of insects such as mayflies, caddisflies, dragonflies, and midges were abundant (TUSI 1980). Population densities of benthic macroinvertebrates at the 11 sampling stations ranged from 24 organisms per yd^2 to 6,264 organisms per yd^2.

Density values in Duck Creek ranged from 204 organisms per yd^2 to 6,264 organisms per yd^2. Tendipedidae, Hydropsychidae, Opisthopora, and Oligochaeta were the predominant taxonomic groups at both Duck Creek stations.

Fish. Fish, the primary consumers in the aquatic community, depend on lower trophic levels. As a primary consumer, they are susceptible to contamination that can occur through food chain bioaccumulation, direct changes in water quality such as increased toxic elements, lowered dissolved oxygen concentrations, sudden or extreme changes in temperature or pH, and elimination of lower food chain organisms.

Fairly high numbers of fish species were collected in project area (Table 6-30). A total of 32 species of fish were collected from all locations combined. The mosquito fish (Gambusia affinis), red shiner (Notropus lutrensis), and ribbon shiner (N. fumeus) were the most numerous species.

Twenty-two species of fish were collected at the two stations on Duck Creek (TUSI 1980). The ribbon fish, mosquito fish, and bluntnose darter (Etheostoma chlorosamum) were most abundant. The longear sunfish (Lepomis megalotis), grass pickeral (Esox americanus), and common carp (Cyprinus carpio) were the species collected in the greatest biomass (TUSI 1980).

Productivity. Primary productivity (milligrams of fixed carbon per cubic meter per hour) ranged from 1.45 to 18.39 at sampling locations in the project area (Table 6-30). The higher productivity measurements were calculated for stations on the Navasota River.

Productivity values (4.32 to 6.92) obtained for Duck Creek do not indicate a eutrophic or polluted environment (TUSI 1980).

6.6.1.2 Terrestrial Communities

Vegetation. The project area is in the Post Oak Savanna (Gould 1975), an area that generally corresponds to Ecoregion 2510 of the Prairie Parkland Province, as defined by Bailey (1980). The Prairie Parkland Province covers most of east-central Texas. The approximate acreages for major land cover types in the Post Oak Savanna are agricultural land (44%), rangeland (40%), forest (11%), and urban (5%) (USDA 1979). However, in the project area there is a much higher percentage of agricultural land (cropland and/or pasture) than forest or rangeland -- 67% versus 26% and 6%, respectively (TDWP 1978). Much of the forest and rangeland in the project area has been subjected to extensive grazing pressure by livestock (TUSI 1980). Nine specific habitat types were identified in 1973-74 during field investigations. A listing of representative plant and animal species from each of the nine communities (habitats) is provided in Table 6-31. Sampling locations during the 1973-74 survey are depicted on Figure 6-14.

Two basic vegetation units (forest and grassland) exist on the Twin Oak project site (Figure 6-15). Forest habitats include the upland forest and riparian forest (bottomland forest); grassland habitats include unimproved pasture, improved pasture, and old field. Creek/stream habitat also occurs in the project site as does the pond/tank habitat. Agricultural lands (pasture) occur primarily in grassland habitat; no cropland occurs on the project site (TUSI 1980).

Vegetation in the upland forest consisted predominately of post oak (*Quercus stellata*) and blackjack oak (*Q. marilandica*) in the overstory, with American beautyberry (*Callicarpa americana*), yaupon (*Ilex vomitoria*), deciduous holly (*I. decidua*), farkleberry (*Vaccinium arboreum*), and Virginia creeper (*Parthenocissus quinquefolia*) as common understory species. Approximately 27% (916 acres) of the Twin Oak project site was covered in upland forest, an important habitat for numerous birds, mammals, and reptiles.

Riparian vegetaton on the project site occurred primarily along major streams. Predominant overstory vegetation included pecan (*Carya illinoensis*), winged

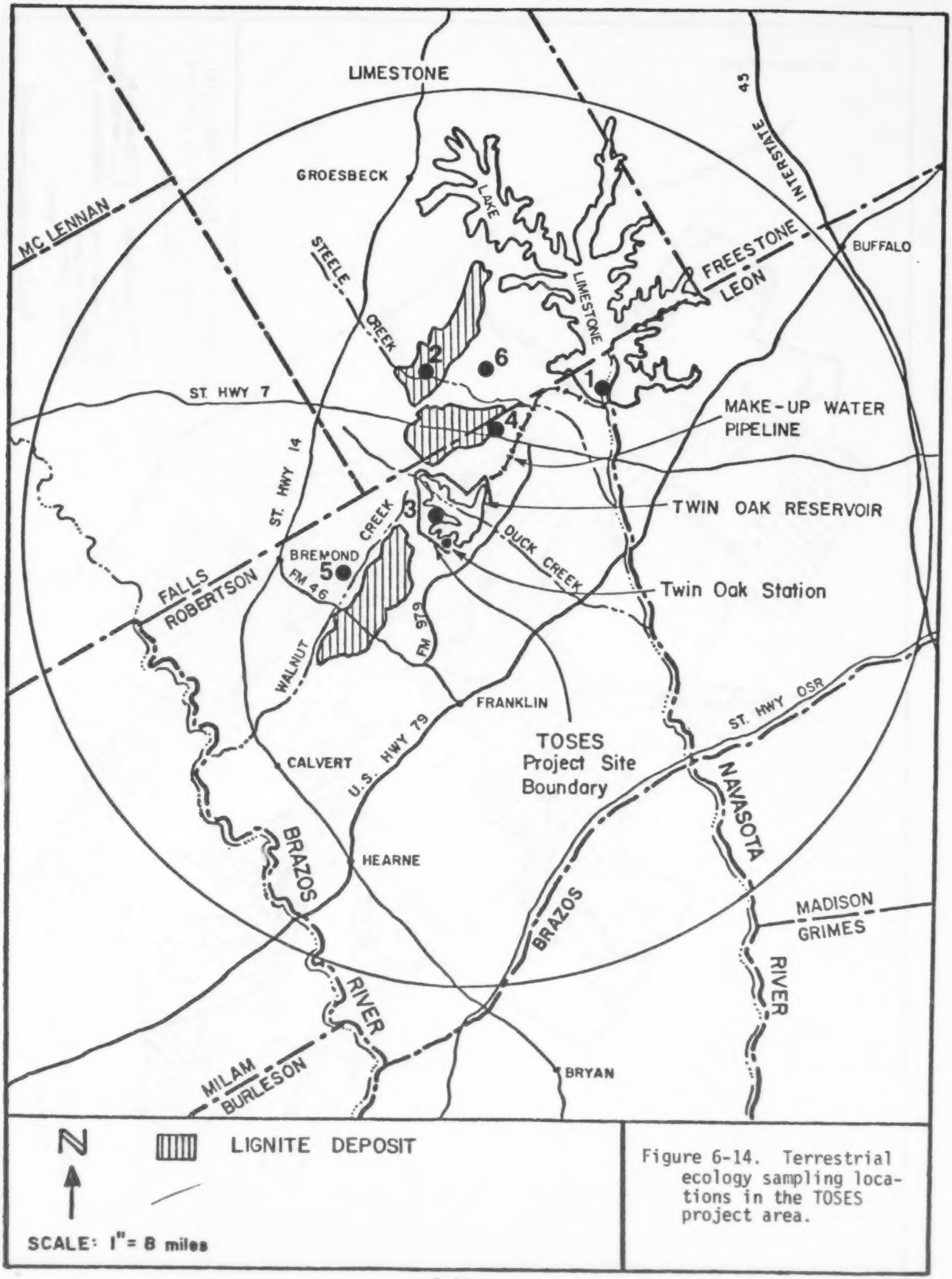
Table 6-31. Representative plant and animal species in nine habitats in the TOSES project area.

HABITAT TYPE	PLANTS	BIRDS	MAMMALS	REPTILES	AMPHIBIANS
Upland Forest	Post oak	Red-headed woodpecker	Fox squirrel	Three-toed box turtle	Couch's spadefoot
	Blackjack oak	Yellow-bellied sapsucker	Coyote	Texas spiny lizard	Hurter's spadefoot
	Possumhaw	Blue jay	Opossum	Ground skink	Texas toad
	American beautyberry	Myrtle warbler	White-tailed deer	Texas rat snake	
	Farkleberry	Tufted titmouse	White-footed mouse	Western earth snake	
Riparian Forest	Winged elm	Great-horned owl	Eastern gray squirrel	Three-toed box turtle	Gree treefrog
	Sugar hackberry	Carolina chickadee	Bobcat	Green anole	Red-spotted newt
	Pecan	Yellow-shafted flicker	Gray fox	Texas brown snake	Southern leopard frog
	Green briar	Eastern bluebird	Coyote	Ground skink	Eastern narrow-mouthed frog
	Post oak	Cardinal	Raccoon	Rough green snake	Tiger salamander
Unimproved Pasture	Spindlefruit sedge	Cattle egret	Plains pocket gopher	Ornate box turtle	Texas toad
	Little bluestem	Marsh hawk	Coyote	Southern prairie lizard	Gulf coast toad
	Panicum species	Cedar waxwing	Thirteen-lined ground squirrel	Six-lined racerunner	Woodhouse's toad
	Elliot bentgrass	Loggerhead shrike	Hispid cotton rat	Eastern yellow-bellied racer	Southern leopard frog
	Purpletop	Eastern meadowlark	Striped skunk	Eastern coachwhip	
Improved Pasture	Bermudagrass	Cattle egret	Plains pocket gopher	Ornate box turtle	Texas toad
	Sedge species	Turkey vulture	Coyote	Southern prairie lizard	Woodhouse's toad
	Vetch species	Horned lark	Thirteen-lined ground squirrel	Spotted whiptail	Southern leopard frog
	Ragweed	Common crow	Eastern mole	Eastern coachwhip	Great plains narrow-mouthed toad
	Prairie crusea	Robin	Striped skunk		
Old Field	Broomsedge bluestem	Red-tailed hawk	Coyote	Ornate box turtle	Hurter's spadefoot
	Western ragweed	American goldfinch	Nine-banded armadillo	Six-lined racerunner	Spotted chorus frog
	Red lovegrass	Fox sparrow	Opossum	Prairie kingsnake	Texas toad
	Yankeeweed	Slate-colored junco	White-tailed deer	Eastern coachwhip	Gulf coast toad
	Texas wintergrass	Grasshopper sparrow	Hispid cotton rat	Texas rat snake	Woodhouse's toad
			Spotted skunk		

Table 6-31. Representative plant and animal species in nine habitats in the TOSES project area (concluded).

HABITAT TYPE	PLANTS	BIRDS	MAMMALS	REPTILES	AMPHIBIANS
"Edge Habitat" (fencerows, wood margins, etc.)	Silver bluestem Indiangrass Little bluestem Post oak Blackjack oak Sugar hackberry	Yellow-billed cuckoo Sparrow hawk Bobwhite Eastern kingbird Mockingbird	Nine-banded armadillo Opossum White-tailed deer Fulvous harvest mouse Eastern cottontail	Six-lined racerunner Texas spiny lizard Southern prairie lizard Texas brown snake Great plains rat snake	Texas toad Gulf coast toad Woodhouse's toad Southern leopard frog
Cropland	(No row crops grown now)	Rockdove Brewer's blackbird Red-winged blackbird Pickcissel Great-tailed grackle	Opossum Raccoon California jack-rabbit Nine-banded armadillo	Ornate box turtle Six-lined racerunner Texas patch-nosed snake	Hurter's spadefoot Upland chorus frog Strecker's chorus frog Texas toad Woodhouse's toad
Creek/Stream	(Small amounts of submerged macro-phytes) Phytoplankton	Wood duck Common snipe Little blue heron Black-crowned night heron Belted kingfisher	Beaver Nutria	Texas slider Red-eared turtle Pallid spiny softshell Broad-banded water snake Diamondback water snake Western cottonmouth	Bronze frog Blanchard's cricket frog Southern leopard frog Spring peeper Bullfrog
Pond/Tank	Cattails Sedges Duckweed	Mallard Gadwall Great blue heron Pied-billed grebe American coot	Beaver Nutria	Yellow mud turtle Red-eared turtle Western ribbon snake Diamondback water snake	Bullfrog Bronze frog Pickerel frog Southern leopard frog

Source: Texas Utility Services, Inc. 1980. Environmental information document and appendix for Twin Oak electrical station, Robertson County, Texas. Prepared for US Environmental Protection Agency. Dallas TX, variously paged.


LIMESTONE
GROESBECK
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BUFFALO
FREESTONE
LEON
MC LENNAN
STEELE CREEK
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ST. HWY 7
MAKE-UP WATER PIPELINE
4
ST. HWY 14
3
TWIN OAK RESERVOIR
CREEK
DUCK CREEK
BREMOND
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FM 46
Twin Oak Station
FALLS
ROBERTSON
FM 979
WALNUT
FRANKLIN
TOSES Project Site Boundary
ST. HWY OSR
CALVERT
U.S. HWY 79
NAVASOTA
HEARNE
BRAZOS
BRAZOS
MADISON
GRIMES
RIVER
RIVER
MILAM
BURLESON
BRYAN
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LIGNITE DEPOSIT
SCALE: 1" = 8 miles

Figure 6-14. Terrestrial ecology sampling locations in the TOSES project area.

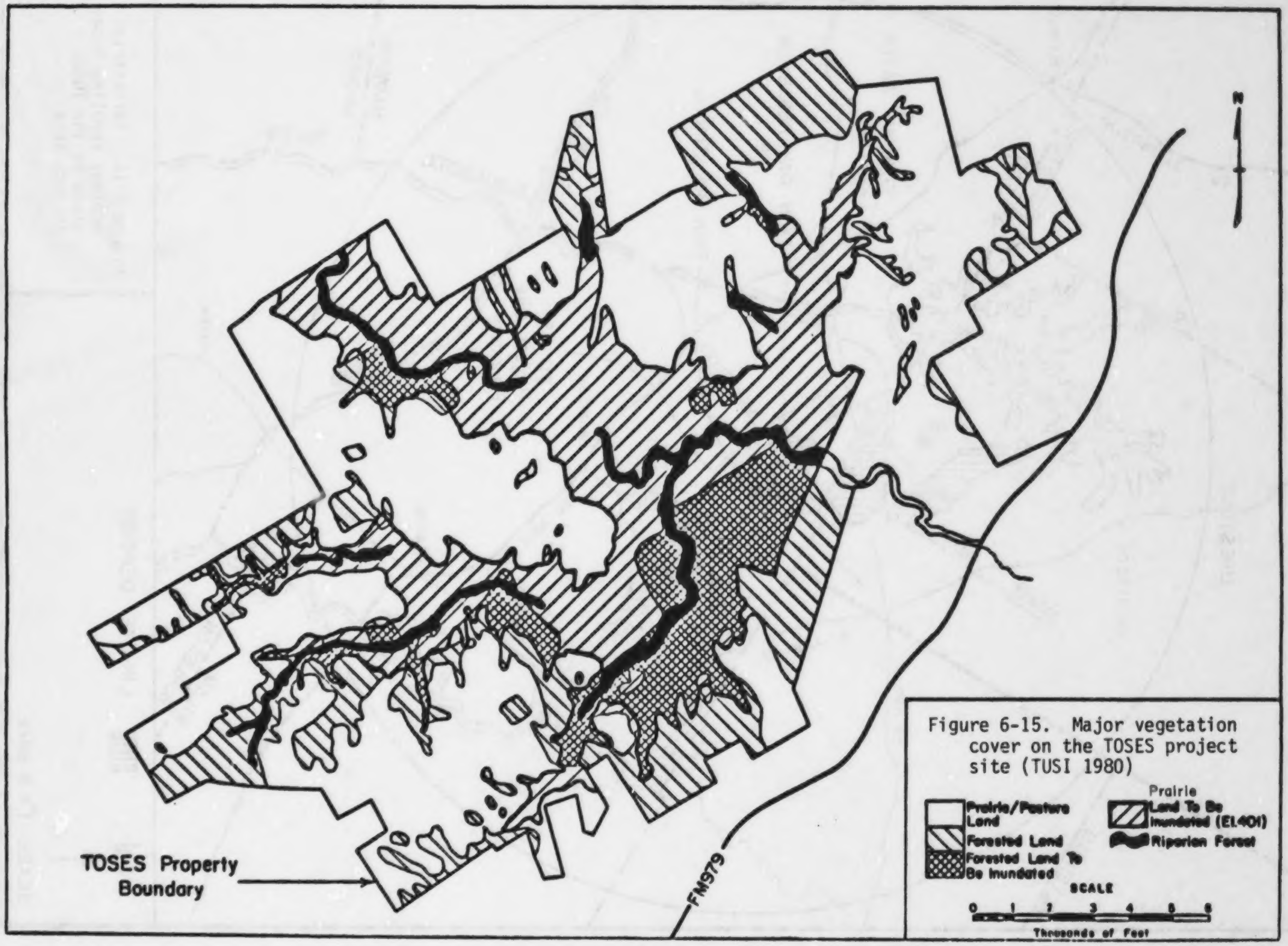

Figure 6-15. Major vegetation cover on the TOSES project site (TUSI 1980)

N
FM979
TOSES Property Boundary
Prairie/Pasture Land
Forested Land
Forested Land To Be Inundated
Prairie Land To Be Inundated (EL401)
Riparian Forest
SCALE
0 1 2 3 4 5 6
Thousands of Feet

elm (Ulmus alata), post oak, laurel oak (Quercus laurifolia), and Texas sugarberry (Celtis laevigata). Representative understory species were greenbriers (Smilax spp.), and various woody vines.

Riparian forest covered approximately 4% (136 acres) of the TOSES project site and paralleled 5.4 miles of stream (Figure 6-15). Less than 1% of this area contained standing or running water. Overstory vegetation consisted of winged elm, sugar hackberry, and post oak. Greenbrier was the predominant understory species. Due to the ephemeral nature of Duck Creek, species occupying this habitat were not clearly distinguishable from those of the upland forest.

A mixture of grassland habitat occurred over the remainder of the Twin Oak project site. The mixture of improved pasture, unimproved pasture, and old fields contained plant compositions from pure monocultures of bermuda grass (Cynodon dactylon), to areas containing mixtures of native and invading grass and weed species. Species representative of grasslands included little bluestem (Schizachyrium scoparium), broomsedge (Andropogon virginicus), Elliots bentgrass (Agrostis elliottiana), and various sedges (Carex spp.), panic grasses (Panicum spp.), and vetches (Vicia spp.).

Grasslands accounted for approximately 69% (2,341 acres) of the areal extent of the TOSES project site, and a large but currently unquantified acreage of the area to be mined. The value of these areas for wildlife varies with plant composition and grazing pressure. Most of the pastures are overgrazed (TUSI 1980).

There are numerous ponds/tanks on the Twin Oak project site and proposed mining sites. These depressions are frequently dry during droughts, but during wetter periods are used by cattle and wildlife as a source of water and in some cases, food. Vegetation in and along the margins of ponds/tanks typically consists of cattails (Typha sp.), vetches, rushes (Juncus sp.), and duckweed (Lemna sp.). The acreages for these areas were included in the riparian acreage.

Wildlife. The TOSES project area occurs in the Texan Biotic Province (Blair 1950). Forty-nine species of mammals, 16 species of lizards, 2 species of land turtles, 39 species of snakes, 23 species of anurans, and over 300 species of birds are known to occur in this province. The mixture of grasslands with upland and bottomland forests provide habitat for a diverse assemblage of wildlife species, although none is endemic. The mixture of habitat also produces considerable ecotone or edge habitat. The names of the more common species found in each habitat are listed in Table 6-31.

Wildlife represented in the upland forest habitat include amphibians such as Couche's spadefoot (*Scaphiopus couchi*), Hunter's spadefoot (*S. holbrooki*), and the Texas toad (*Bufo speciosus*). Reptiles observed during field surveys included the three-toed box turtle (*Terrapene carolina*), Texas rat snake (*Elaphe obsoleta*), and Texas spiney lizard (*Sceloporus olivaceus*). Common bird species present were the Red-headed Woodpecker, Yellow-bellied Sapsucker, Tufted Titmouse, Blue Jay, and Myrtle Warbler. Common mammals found in this habitat were the opossum (*Didelphis marsupialis*), coyote (*Canis latrans*), and the white-footed mouse (*Peromyscus leucopus*). The whitetail deer (*Odocoileus virginianus*), and the eastern fox squirrel (*Sciurus niger*) were the most common game species.

The riparian forest generally is important to wildlife due to the high productivity and the relatively high diversity of plant species. Typical amphibian species include the green treefrog (*Hyla cinerea*), red-spotted newt (*Notophthalmus viridescens*), and southern leopard frog (*Rana utricularia*). Reptiles observed included the green anole (*Anolis carolinensis*), ground skink (*Leiolopisma laterale*), and the rough green snake (*Opheodrys aestivus*). Birds commonly observed were the Cardinal, Eastern Bluebird, Common Flicker, Carolina Chickadee, and Great-horned Owl. Common mammals include the gray fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), and the coyote; all four species of mammals are economically important furbearing species. The whitetail deer and eastern gray squirrel (*Sciurus carolinensis*) were the most common game mammals occurring in this habitat.

Amphibians and reptiles observed in the grassland areas included Woodhouse's toad (*Bufo woodhousei*), Gulf Coast toad (*Bufo valiceps*), ornate box turtle (*Terrapene ornata*), eastern coachwhip (*Masticophis flagellum*), and sixline racerunner (*Cnemidophorus sexlineatus*). Bird species found in this habitat included the American Robin, Fox Sparrow, American Goldfinch, Red-tailed Hawk, Marsh Hawk, and Cattle Egret. Common mammals included the hispid cotton rat (*Sigmodon hispidus*), opossum, striped skunk (*Mephitis mephitis*), spotted skunk (*Spilogale putorius*), and armadillo (*Dasypus novemcinctus*). The whitetail deer and eastern cottontail rabbit (*Sylvilagus floridanas*) were the only game mammals reported from grassland habitats.

Non-forested wetland areas such as ponds/tank habitats are important to many species of wildlife. Amphibians commonly found in these habitats included the bullfrog (*Rana catesbeiana*), bronze frog (*Rana clamitans*), pickerel frog (*Rana palustris*), and southern leopard frog. Reptiles observed were the red-eared turtle (*Chrysemys scripta*), diamondback water snake (*Natrix rhombifera*), yellow mud turtle (*Kinosternon flavescens*) and western ribbon snake (*Thamnophis proximus*). Many birds were found in these habitats. The most common aquatic species included the Mallard, Gadwall, Great Blue Heron, Pied-billed Grebe, and American Coot. The mammals frequenting pond/tank habitat were the beaver (*Castor canadensis*) and nutria (*Myocastor coypus*). It should be noted that the areas surrounding these tanks and ponds generally are productive and that a diversity of terrestrial species depend on this habitat for nesting, feeding, and other vital activities.

6.6.1.3 Endangered or Threatened Species

Six species of wildife, the Bald Eagle, Atwater's Prairie Chicken, Whooping Crane, Redcockaded Woodpecker, American alligator (*Alligator mississippiensis*), and Houston toad (*Bufo houstonensis*) were listed by the US Department of the Interior Fish and Wildlife Service (USFWS) to be considered in this project. One additional endangered species, the American Peregrine Falcon, also occurs in the project area. All are listed as endangered by the USFWS (1980). The following discussion summarizes the distribution and occurrence of each endangered species considered.

The American Peregrine Falcon was the only endangered species observed by field investigators in the project area. This species is not a permanent resident of the project area, and does not utilize habitats on the TOSES project site on a regular basis (TUSI 1980).

The Bald Eagle nests predominantly in coastal areas of Texas and along major rivers and lakes. It is likely that a Bald Eagle would occur in the project area and/or project site along the Navasota River, Lake Limestone, or when complete, Twin Oak Reservoir; none was observed during field surveys (TUSI 1980). An active Bald Eagle nest is known to exist in a forested habitat adjacent to Lake Limestone in Robertson County (By letter, Thomas Cloud, US Fish and Wildlife Service, 13 January 1981).

Attwater's Prairie Chicken is a medium-sized grouse that inhabits the tall-grass coastal prairies (USFWS 1980). Historically the bird has ranged as close as Brazos County (one county south of the project site). The bird's present distribution is limited northward to Austin and Harris Counties. There were no reported sightings of Atwater's Prairie Chickens during the 1973 and 1974 field surveys.

The Whooping Crane is a large, migratory wading bird that may pass over Robertson County during its fall and spring migrations. There are no recent sight records of the Whooping Crane in Robertson County or adjacent counties.

The Red-cockaded Woodpecker was not observed during the 1973-1974 field surveys. The species nests only in large mature pine trees, none of which is available on the Twin Oak project site. All sightings since 1950 have occurred at least 50 miles east of the proposed TOSES project site (Oberholser 1974).

The American alligator is reported to range as far west as Robertson County. Alligators inhabit streams, swamps, and other wetlands. Potential habitat for the alligator occurs in the Navasota River, Lake Limestone, and several creeks and ponds in the project area. The Texas Parks and Wildlife Department (TPWD) estimated the alligator population in Freestone County at 107 and the population in Leon County at 150 in 1974 (Potter 1975). A more recent estimate (1980) put the Limestone County population at 10 alligators (by phone, Bill Brownlee, TPWD, 19 November 1980). Smith reported that the alligator population in Robertson County was 29 in 1973 (Espey, Huston and Associates 1980c), however no alligators were observed during field surveys in 1973 (TUSI 1980).

The Houston toad is a small toad similar in appearance to the American toad (Bufo americanus). The Houston toad's preferred habitat includes sandy areas containing temporary standing water. It is currently believed to be confined to designated critical habitat immediately south of Robertson County in Burleson and Bastrop Counties.

One additional species Spiranthes parksii, an orchid occurring in nearby Brazos County, currently is proposed for listing on the USFWS list of endangered and threatened wildlife and plants native to the United States. None was encountered in the 1973-1974 surveys (TUSI 1980).

Much of the information provided in this subsection was summarized from a more thorough discussion which occurred in a "Biological Assessment" provided to the USFWS by EPA in March 1982.

6.6.2 Environmental Consequences From the No Action Alternative

If the TOSES and associated facilities are not fully developed on the project site, the site will remain nearly as described in Section 6.6.1. However, due to the trend in land development (i.e., conversion of forested land to agricultural or pasture land), the distribution and abundance of forest species of vegetation and wildlife are expected to decrease. Some effects have occurred to date due to clearing and construction. Most of these effects have been localized, and restricted to the areas disturbed or immediately adjacent to disturbed areas.

6.6.3 Environmental Consequences From the Construction and Operation of the Proposed Project

6.6.3.1 TOSES and Associated Facilities

Aquatic Communities. Approximately 5.6 miles of stream, predominately along Duck Creek, will be removed by the construction of the TOSES and Twin Oak Reservoir. When filled, the reservoir will inundate virtually all of Duck Creek and its tributaries on the project site. Aquatic plant and animal species dependent on lotic (running water) environments will be in time replaced by species that live in lentic (standing water) environments. Short-term adverse effects to aquatic communities on the project site will occur, and the populations of aquatic flora and fauna that cannot exist in the lentic environment will decline. Since the acreage of aquatic habitat on the project site will increase dramatically over the long-term, net impacts caused by construction activities once the reservoir is filled should be positive.

Operation of the TOSES and Twin Oak Reservoir will result in a shift in the existing species in Duck Creek downstream of the reservoir. Annual operational releases and occasional flood flows will favor lotic species. During the operation of the proposed TOSES, aquatic biota will be affected by the intake of cooling make-up water, runoff from the plant area sanitary sewer discharge, and floor drainage. No adverse effects are expected from toxic discharges, such as selenium, since a closed cycle waste treatment will be used and periodic discharges will be treated to meet TDWR standards.

The design, location, volume, and velocity of water intake determine the degree of adverse effects to aquatic organisms by the intake structures (Boreman 1977). Generally, entrainment and impingement of aquatic organisms is largely prevented by placing the intakes below the thermocline as in the case of Twin Oak. However, Texas reservoirs generally change from their stratified, summertime conditions with anoxic conditions near the bottom, to a wintertime non-stratified vertical distribution of dissolved oxygen, pH, and temperature (Texas Department of Water Resources 1978). Under such a regime, impingement and entrainment would be lessened in Lake Limestone during summer only. However, the numbers of impinged and/or entrained aquatic organisms (including fish larvae) are still expected to be low because of the low approach velocities, conventional screening devices, chlorination procedures, and aquatic organism screen wash system. The design of the intake facility on Lake Limestone has been reviewed and approved as best available technology by EPA.

Terrestrial Communities. Construction and operation of the TOSES, cooling reservoir, and associated facilities will eliminate or alter approximately 3,393 acres of terrestrial habitat. Reservoir filling will remove 5.6 miles of riparian habitat along Duck Creek. Approximately 2,341 acres of grassland (pasture and old field) habitat, 916 acres of upland forest, and 136 acres of riparian and tank/pond habitat will be converted to other habitat or eliminated (TUSI 1980). Some of the less mobile wildlife species such as many amphibians, reptiles, mammals, and young of all groups, including birds, will be injured or die during the site preparation and construction activities. Other more mobile forms should escape to adjacent habitat. However, adjacent habitats contain only given quantities of resources and competition with resident individuals for available resources may occur. Data from progressive studies by the Texas Parks and Wildlife Department show that forest habitat has decreased drastically in East Texas over the past decade due to development (Brown and Frye 1981).

Because species diversity and productivity are very high in riparian habitats, loss of riparian habitat will represent the most serious long-term loss of biological productivity. The loss of upland forest is also significant, but less so due to the available acreages of upland forest habitat in adjacent areas.

In the 2,330 acres flooded by Twin Oak Reservoir, terrestrial productivity will cease. Peripheral wetlands or semi-wetland areas created by the reservoir will enhance productivity on the project site by increasing water available for use by terrestrial and semi-aquatic wildlife. Migrating water birds such as ducks, grebes, and coots will use the reservoir annually, especially during winter months. Although lake-shore habitats do not provide the diversity of structure that stream-side habitats provide, considerably more lakeshore habitat will exist. A buffer zone of approximately 8,600 acres of additional Company owned land around Twin Oak Station and Reservoir will be fenced. Recreational and agricultural activities will not be permitted in this fenced area, thus creating an increment of undisturbed, terrestrial habitat that will be utilized by a diversity of wildlife species.

Operation of the TOSES will result in increased noise and human activity near the plant site. Most wildlife species adapt to noise and should in time reestablish in areas adjacent to the plant site. However some of the larger, more secretive species, such as whitetail deer, gray fox, etc., may continue to avoid areas of increased human activity.

Impacts on the biological resources due to air emissions from the TOSES are expected to be minimal since the plant is designed to meet the NAAQS.

Possible secondary impacts associated with operation include: a decline in primary production in vegetation adjacent to construction activities due to dust accumulation on foliage and/or foliar injury due to vehicular exhaust emissions; an increase in the number of vehicular related deaths and injuries to wildlife due to an increase in the local traffic volume; and an increase in poaching and harassment of wildlife.

Endangered or Threatened Species. No endangered or threatened species or critical habitat of listed species are known to occur on the Twin Oak project site. The development of Twin Oak Reservoir will create potential habitat for the Bald Eagle and American alligator. EPA has determined that the proposed construction and operation of TOSES will have no effect on any listed species. The US Fish and Wildlife Service has agreed with this determination (USFWS 1982).

6.6.3.2 Transport Systems

Construction of transportation corridors has or will disturb, modify, or destroy approximately 109 acres along the make-up water pipeline, 822 acres along the railroad spur, and 1,502 acres along the electric transmission line. Of the 3,089 acres utilized for the power transmission line right-of-way, 1,587 acres already exists as right-of-way.

Aquatic Communities. Adverse effects associated with transport facility construction include short-term erosion and sedimentation at stream or lake crossings. Where forested streams or waters are intersected, these short-term impacts may be severe, and temporary reductions in populations of all aquatic organisms may result. Erosion prevention techniques will be employed to minimize these effects.

Some localized long-term impacts will also be associated with normal maintenance or operation of transport corridors, especially where forested streams are encountered; water temperatures will increase, as well as phytoplankton production and aquatic macrophyte production at these crossings due to greater exposure to sunlight.

Terrestrial Communities. The most severe adverse effects associated with transport systems will occur in forested areas, especially areas with steep slopes where the erosion potential will be high. The railroad spur will pose a barrier to some of the smaller less mobile species of wildlife, and the operation of the railroad will result in some deaths and injury to wildlife. All of the corridors will increase the acreage of edge habitat and field habitat, and thus benefit plants and wildlife that utilize these zones. In addition, corridors may provide increased human access to areas previously unaccessable. This may result in degradation to plant and wildlife species near these access points.

6.6.3.3 Mine

Aquatic Communities. Major land modifying activities (i.e., sedimentation pond construction, stream diversion, and levees construction, etc.) that occur prior to mining will damage or destroy aquatic communities on the mining sites and immediately downstream. Stream drainage diversions will drain streams and eliminate most aquatic organisms between the diversion and sedimentation pond. During construction of sedimentation ponds and drainage diversions, cleared areas and earth dams may erode prior to, during, and after reclamation. Increased sedimentation from erosion may occur downstream of sedimentation ponds. The following are potential effects associated with increased sedimentation from activities prior to mining:

- reduced phytoplankton diversity due to decreased light transmission caused by increased turbidity;
- smothering of benthic invertebrates caused by increased sedimentation and consequent reduction in the supply of food available to fish;
- clogging of fish gills by sediment;
- elimination of fish spawning grounds or covering of fish eggs by sediment;
- reduction of benthic habitat diversity due to sedimentation;

- increased stream nutrient levels and increased eutrophication potential;
- increased stream bed and bank erosion near construction activities;
- reduced biological productivity and diversity.

The quantity and intensity of rainfall that occurs during this construction period is an important factor. Application of straw, matting, or other materials to prevent erosion will mitigate the magnitude of adverse effects to aquatic organisms.

In addition to the above effects, the diversion of water, or retention of water by sedimentation ponds may reduce downstream flows. Stream segments directly below sedimentation ponds will receive diverted water from areas above mining in certain situations, and in other situations will be separated from headwaters, or effectively converted to headwaters. The characteristics of these streams may be altered; channels may be narrower and shallower, and exhibit habitat qualities approximating the removed upstream segments. Streams should reconstruct downstream in a manner approximately equal to the removed segment. Aquatic organisms associated with these segments will reflect similar changes in diversity.

Many of the above effects to aquatic communities will be short-term if reclamation successfully returns stream channels to their original pre-mining condition as required by Texas Railroad Commission Coal Mining Regulations (Section 051.07.04 364).

Clearing of on-site vegetation will result in loss of aquatic organisms during the time the land is left exposed following site preparation. Most stream segments that have been cleared of vegetation will erode and fill with silt prior to or during mining. Effects that lead to the elimination of aquatic communities during and immediately after vegetation removal include:

- reduction of detrital (dead plant material) input to the receiving streams and consequent reductions in stream productivity;
- increased stream temperatures caused by removal of shade trees and consequent reductions in stream benthos and fish;

- reduced nutrient and sediment filtering efficiency of surface runoff; and
- increased sedimentation and turbidity resulting in the elimination of primary producers (phytoplankton, zooplankton, etc.).

Removal of the overburden and lignite will eliminate the remaining aquatic communities by (1) direct removal of stream segments and ponds, (2) creation of mine pits, and (3) creation of spoil piles. Complete or partial removal of a stream segment will eliminate all remaining aquatic plants and animals in the affected area. On-site streams largely are intermittent, and as ponds and diversion ditches are built, long-term effects on the aquatic communities will be lessened. Further, although aquatic plants and animals initially will be lost, mined streams and ponds eventually may become repopulated over a period of several years if a successful reclamation plan is implemented that restores streams to their approximate pre-mining course and grade, including features such as meanders, riffles, and pools. At present, no studies exist that indicate whether or not streams can be restored effectively in East Texas.

Effects caused by the creation of mine pits primarily will be related to potential changes in surface water quality and stream flow regimes. Water accumulating in the pits from surface runoff and aquifer discharge will contain various trace metals, and dissolved and suspended solids which will be dishcarged into temporary sedimentation ponds for settling. Appropriate sedimentation control measures will be established according to TRC regulations (Section 051.07.04.513) regarding the prevention of stream flow runoff outside permit areas and sediment control measures using proper mining and reclamation practices. Effluent control from sedimentation ponds of optimal size should follow TRC regulations regarding sediment storage volume, pond detention time, and dewatering, and should meet established TRC effluent limitations. If these measures are effective, the long-term effects on aquatic communities should be minor.

Creation of mine pits could cause localized lowering of water tables in the immediate vicinity of the mine as water from surface runoff and aquifer discharges accumulates in the pits. Because riparian and other wetland vegetation is sensitive to changes in moisture, adverse effects to nearby areas could occur if the water table is lowered by the mine pit (Darnell et al. 1976).

Sedimentation ponds will be constructed as necessary to prevent any spoil pile from entering downstream waters until discharges meet both State and Federal water quality standards. Some fugitive dust will originate from the spoil piles and be deposited in nearby streams and ponds. If spoil pH in the mining area varies widely due to pyrite materials in the overburden, the potential exists for isolated acid leaching. If acid drainage enters streams due to malfunctioning of sedimentation controls, it could have the following adverse effects on the aquatic community:

- direct toxic effects of low pH, and/or trace metals resulting in injury or death to mature animals or damage to their eggs;
- smothering of benthic invertebrates by iron and manganese precipitates; and
- smothering of fish by coating gills with iron precipitates, a condition known as "yellow boy".

The potential for mining discharges of low pH is lessened by operation of sedimentation ponds. Additionally, EPA's NPDES permit, if issued, will limit pH levels to between 6 and 9. Proper stream segment reconstruction after mining can mitigate certain losses to the aquatic community. Additionally, if precautions are taken to ensure that sedimentation ponds are relatively free of toxic substances, many can be left, resulting in additional aquatic habitat.

Loading and hauling the lignite will produce fugitive dust, some of which will be deposited in nearby streams and ponds where it could adversely affect aquatic plants and animals. However, the effect of this deposition should be highly localized and, if roads are frequently watered, should be insignificant. Other potential effects of lignite transport could include leaching of trace elements and other materials from haul roads made with lignite ash, but little is known about the possible magnitude of these effects on aquatic life.

Reclamation will have some short-term and long-term adverse effects on aquatic communities. Generally, revegetation of the land following mining will reduce erosion and runoff and restore stream water quality in previously mined areas. However, in areas where forest is converted to pasture, increased levels (above forest) of erosion and runoff may continue to degrade water quality if the land is not maintained properly (Moore and Hittman 1977). Texas Utilities' past experience indicates that post-mining land users are on the whole managing their pastures properly.

An additional potential adverse effect could arise from sulfate and trace metal ion runoff into reclaimed streams or ponds. Sulfate runoff can be expected to continue in reclaimed areas if oxidized pyrite is available in the soil, even though the soil is well buffered (Hill and Grim 1975). Trace metal and dissolved ion runoff may continue for months or even years following revegetation, due to their presence in the overburden. During the period following mining when the soils are still compacting and during periods of heavy rainfall, some increases can be expected in dissolved solids runoff, with a corresponding adverse effect on aquatic communities. These potential downstream effects can be mitigated partly by leaving sedimentation ponds (and diversions) in place for several years following mining. However this would result in a continued lower flow to downstream segments.

Reclaimed areas that do not respond to the first attempt at revegetation may have to be relimed and/or refertilized, which may further reduce the water quality of affected streams. Further, ammonia fertilizer may not be fully usable by terrestrial vegetation because low soil pH inhibits biological nitrification of ammonia to nitrite and nitrate (and subsequent use of nitrate by plants), and there is an overall lower efficiency of use of ammonia by vegetation as compared to nitrate (Hons et al. 1978). To avoid this problem, use of ammonia-free fertilizers (e.g., $Ca(NO_3)_2$ or KNO_3) could be employed, although precautions such as split applications should be considered to prevent runoff of excess nitrate (Hons et al. 1978).

Assuming successful reclamation, many of the effects previously described will be mitigated. However, most of the land adjacent to streams will be returned to grasslands and overall long-term decreases in aquatic habitat diversity and accompanying species diversity will persist.

Terrestrial Communities. The most significant adverse effects of major land modifying activities prior to mining will occur primarily in the riparian and forested bottomland habitats. Construction of diversions, levees, drainage ditches, and ponds prior to mining will eliminate vegetation, increase soil erosion, and eliminate or reduce water flow (depending on the time of year) with consequent reductions in riparian vegetation in downstream areas.

Effects from elimination of vegetation and increased soil erosion have been discussed. Elimination or reduction of water in riparian habitats will prevent nutrient regeneration from occurring, a process on which the productivity of this community depends (Darnell 1976). However, reparian communities in the mining area are primarily associated with intermittent streams, which are not as productive or extensive as those associated with the nearby Navasota River and Little Brazos River. Lowering of the water table along drainage structures could also produce localized drying and reduction in soil moisture, possibly reducing the growth and abundance of vegetation in the area around the mine.

Construction and operation of sedimentation ponds will primarily affect the stream and river ecosystems, but there also will be the loss of forests, grasslands, and/or agricultural lands as these communities are converted to ponds. These conversions may lower the local water table, reduce soil moisture, and reduce groundwater recharge as a result of surface drainage into the ponds, and thus produce changes in terrestrial vegetation in and immediately around sedimentation ponds.

Removal of terrestrial vegetation will occur during mine site clearing. This activity will degrade or destroy nearly all terrestrial vegetation on the mining sites. Mining is scheduled to begin with the initial removal of topsoil (and vegetation) from 750 acres each year. Currently, data on the exact acreage of each vegetation type to be disturbed is not available. Mining will occur at a continous rate, and once the lignite-bearing strata are removed, surface reclamation and revegetation are expected to proceed. Presently, reclamation will reestablish vegetation cover similar to what presently exists over part of the sites (pasture). Once completed, this plan will provide for proper reconstruction of mine land contours, soil preparation, establishment of vigorous ground cover, and proper management of vegetation following establishment (TUSI 1981). If a 5-year interval between start of mining and return to early pasture is assumed, then severe, direct impacts can be considered relatively short-term.

Effects from clearing will include elimination of all vegetation cover resulting in displacement of wildlife. Timber and brush will be cleared in advance of the mining operation. Trees, stumps, brush, and other refuse will be bulldozed into piles or windrows and burned or buried. Burning done in compliance with Texas air pollution control regulations should not produce significant effects on terrestrial biota. Included also are increases in water and wind erosion. Erosion will increase due to more localized runoff, and increased sedimentation will reduce photosynthesis in receiving waters.

Wind erosion could produce fugitive dust emissions that may affect remaining nearby vegetation, possibly reducing light penetration, photosynthesis, and productivity. If sufficient pyritic material is present in the dust, aluminum, manganese, and other trace metals may be made available for uptake by plants, and cause some minor toxic effects. This phenomenon has been documented in studies by Hons et al. (1978) and Bryson (1973). However, these effects should be localized because the total amount of area affected at any time will be relatively small, and reclamation will immediately follow mining.

Riparian habitats are productive, diverse, and sensitive communities. Clearing of such areas will eliminate any natural filtration (green belt) provided by the vegetation along the water's edge. Other potential effects of removal of this vegetation include reduction of detrital input to streams, increased stream bank erosion, and possible increases in downstream flooding and erosion (Darnell et al. 1976).

Additionally, the potential for oxidation of pyritic materials exists from spoil piles. Soils should be tested regularly and chemically treated if necessary to ensure proper pH and successful revegetation of the land during reclamation.

Construction of haul roads also will eliminate vegetation on the mine sites. This will have effects similar to those resulting from other clearing operations previously described. Further, if lignite ash is used during haul road construction, potential adverse effects from leachates of various trace metals into the surrounding soil and uptake by the vegetation is possible. Oil, grease, and asbestos also will be found in runoff from haul roads. Any effects on terrestrial communities from these pollutants should be insignificant, and are expected to be localized and of short duration.

Vehicle emissions will be produced throughout the project and will consist of SO_2, NO_x, hydrocarbons, trace metals, and particulates. Fugitive dust also will be produced by vehicular activity. Effects from these sources on terrestrial vegetation will be highly localized, and are not expected to be significant.

The objective of reclamation is to return lands disturbed by surface mining activities to a land cover condition that is as good or better than that which preceded mining. The dominant pre-mining land cover on the Twin Oak mine sites is pasture. A complete reclamation plan for the proposed mine should at least include:

- reconstruction of mined land to an acceptable contour;
- soil preparation;
- establishment of vigorous ground cover; and
- proper management of vegetation following establishment.

Although surface mining laws and regulations have strict requirements, there exists a potential for adverse effects to occur due to improper reclamation activities or practices. Probably the most important factor for ensuring successful reclamation is returning the soil of the mined area to a condition that will support the former successional vegetation cover. Without this condition, revegetation may fail and in turn, allow increased wind and water erosion, increased downstream water turbidity, and permanent abandonment of reclaimed lands by most species of wildlife.

Other potential effects on terrestrial vegetation during reclamation may result from earth moving, use and removal of haul roads, applications of lime or fertilizers, seeding, and planting of trees. Effects arising from these operations would include increased noise levels and vehicle exhaust emissions, and increased fugitive dust emissions; however, these are not considered to be significant effects, because of their short duration and highly localized nature.

A broader issue relative to effects of reclamation on the mine site is the actual versus the theoretical success of revegetation following mining. The two most important questions relative to reclamation success are listed below.

- Can the reclaimed areas be self sustained following initial liming, soil fertilization, and irrigation?
- What are the effects of continued reclamation efforts, if required (i.e., potential effects of continued fertilization, irrigation, and liming.

To insure that reclamation is successful or affected areas are adequately mitigated, the TRC requires the applicant to bond each area prior to mining.

Endangered or Threatened Species. The American Peregrine Falcon was the only endangered species observed during field surveys of the project area. Since this species is quite mobile and not a resident or frequently occurring species of the project area, the construction and operation of the mine is not expected to endanger the existence of the American Peregrine Falcon.

The American alligator and Bald Eagle both occur in the project area and may occur in the area to be mined. Potential habitat of the American alligator and/or a small segment of the alligator population may be displaced or destroyed by mining. The influx of people into the area as a result of the mining and associated development may result in indirect reductions in local populations of the American alligator due to poaching, and increased harassment, injury, or malicious killing of Bald Eagles (US Fish and Wildlife Service 1980).

6.7 CULTURAL RESOURCES

6.7.1 Existing Conditions

6.7.1.1 Laws and Regulations

Cultural resource investigations are required by law when a project involves Federal financing, assistance, or licensing. The requirements are specified in the following Federal regulations and procedures:

- National Historic Preservation Act of 1966 (PL 89-665) (16 U.S.C. 470 et seq.),
- National Environmental Policy Act of 1969 (PL 91-190)(42 U.S.C. 4321 et seq.),
- Executive Order 11593 (Protection and Enhancement of Cultural Environments).
- Archaeological and Historic Preservation Act of 1974 (PL 93-291) (16 U.S.C. 469 et seq.).
- 36 CRF 800--Protection of Historic and Cultural Properties.
- 36 CFR 60.6--National Register Criteria.
- National Historic Preservation Act Amendment of 1980 (PL 96-515) (16 U.S.C. 470 note).

These regulations and procedures stipulate that EPA, as the Federal permitting agency, has the responsibility to identify, evaluate, and seek determinations of eligibility for all properties within project boundaries that are potentially eligible to the National Register of Historic Places. EPA also has the responsibility to ensure adequate protection, either through preservation or mitigation, of those properties included in or eligible for inclusion in the National Register.

The TOSES project site does not contain any state-owned lands and the requirements of the Texas Antiquities Code will not have to be met unless public roads, through-fares, or rights-of-way are affected. However, because Texas State Historical Landmarks occur within the proposed boundaries of the mining leases, the requirements in the Texas Antiquities Code will have to be met before construction of the mines can begin. Implementation of and compliance with the above Federal regulations and procedures prior to project completion will ensure the adequate identification, evaluation, and mitigation of the cultural resources in the project area.

6.7.1.2 Cultural Resources of the Project Area

The project area is situated in the Central Texas Archaeological Unit (Suhm 1960). Prehistoric habitation sites usually consist of fire-cracked rock and scatters of worked stone; pottery is present but rare. Prehistoric occupation in the Central Texas Archaeological Unit extends back at least 10,000 years, although the major period of occupation was during the Archaic (8000-1250 BP[1]), especially the Middle Archaic, on through the Late Prehistoric (1250-150 BP) periods. Prehistoric occupation was minimal and surficial in the project area.

Historic occupations generally date from the end of the Civil War and consist primarily of farms, farmsteads, and farming communities. The economic base of the project area has historically been agriculture, with cotton being the main crop in the late nineteenth century. Other historic sites include cemeteries, churches, schools, courthouses, and stores.

Several cultural resource investigations have been conducted in the Navasota River drainage, the major drainage in the project area. Cultural resource investigations occurred in conjunction with the construction of Lake Limestone (Prewitt 1974, 1975; Prewitt and Mallouf 1976; Mallouf 1979), and the proposed Millican Dam (Sorrow and Cox 1972). Other investigations include those associated with the Gibbons Creek Lignite Project (Bond 1977; Fletcher 1979; Ippolitto 1979), and the Jewitt Mine and Limestone Steam Electric Generating Station (Espey, Huston and Associates 1980a, 1980b).

The above investigations have established that the Navasota River was important, prehistorically and historically, because it is located between the Trinity River Basin and in the Brazos River Basin, two major prehistoric and historic population loci. The Navasota River drainage served as a transition zone between the two basins. The results of the various investigations in the Navasota River drainage, including those associated with the Twin Oak project, have established that the focal point of prehistoric occupations was in the floodplains, particularly of major streams. Upland areas were also used, but occupations in these areas were more marginal. Historic occupations occurred more frequently on upland areas, particularly areas adjacent to stream valleys.

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[1] BP: "Before Present," indicates time in radio carbon years before AD 1950.

The Federal Register on 6 February 1979 (Vol. 44, No. 26, pt. 2), 18 March 1980 (Vol. 45, No. 54, pt. 2), and 13 February 1981 (Vol. 46, No. 2, pt. 2) includes three sites each in Robertson and Limestone Counties that are listed in the National Register of Historic Places. None of these sites will be affected by the construction of the TOSES and attendant facilities, or by mining operations. There are 51 sites in Robertson County and 49 sites in Limestone County listed as State Historical Landmarks with the Texas Historical Commission. The construction of the TOSES will not affect any State Historical Landmarks. One State Historical Landmark, the grave of James Alfred Head, in Head Cemetery at Bald Prairie, will be disturbed by mining operations. Another site, the Potter Shop is 12 miles east of Thornton on FM 1246 and is on the edge of one of the mining leases. There are listings of 130 sites in Robertson County and 149 sites in Limestone County in the State repository of site files at the Texas Archeological Research Laboratory (TARL) (by letter, Carolyn Spock , Head of Records at TARL, 4 February 1982).

6.7.1.3 Results of Cultural Resource Investigations

The Texas Archeological Survey (TAS) has conducted cultural resource inventories of the power plant and cooling reservoir (Prewitt and Gromebacher 1974) and parts of the mining sites (Turpin and Kluge 1980). The pipeline right-of-way linking the cooling pond with Lake Limestone and the railroad spurs associated with the power plant were also surveyed by TAS (Nightengale 1981). The TAS has published a summary of their activities to date (Dibble 1981). A sampling survey of the transmission corridors has also been completed.

Plant Site. The TOSES project site was surveyed in 1974 by the TAS (Prewitt and Grombacher 1974). No historic or prehistoric sites were located in the boundaries of the TOSES site.

Cooling Reservoir. The cooling reservoir was also surveyed by TAS in 1974 (Prewitt and Gromebacher 1974). Three prehistoric sites, 41RT8, 41RT10, and 41RT11[1] were identified in the boundaries of the reservoir. A fourth site, 41RT9, was located 0.2 miles east of the dam center line. Five historical localities were also located; three (HL3[2], HL4, HL5) were outside the reservoir boundaries and two (HL1 and HL2) were adjacent to but above the maximum floodpool level. Two of the prehistoric sites, 41RT10 and 41RT11, were recommended for further testing to determine their significance. Testing took place in 1979 (Turpin and Kluge 1980) at which time both sites were determined ineligible to the National Register of Historic Places and no further work was warranted. The historical localities are all houses that are above the maximum floodpool level and should not be affected by construction.

Pipeline. The pipeline right-of-way from Lake Limestone to the cooling reservoir has been surveyed (Nightengale 1981). The one minor site located was destroyed by the construction of the pumping station built prior to the initiation of the survey. Three isolated finds consisting of single artifacts or limited cultural material without any cultural context were also reported.

Railroad Spurs. The railroad spur was also surveyed (Nightengale 1981). The one site and one isolated find reported were destroyed by the construction of the spur prior to the survey.

Transmission Corridors. A sampling survey of high probability areas along the transmission corridors recently was completed by the TAS and the resulting report revealed one badly depleted site that did not warrant further work (by phone, David Dibble, TAS, 22 December 1981).

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[1] Site Numbers may be interpreted as follows: 41 = Texas; RT = Robertson County; # = Specific site number in county.

[2] HL = Historical Locality.

Mine Site. A 5,000 acre tract within and adjacent to the first 5-year mining lease was surveyed by TAS (Turpin and Kluge 1980). One historic and twenty prehistoric sites were identified along with nine isolated finds. The prehistoric sites include: 41RT106, 41RT107, 41RT108, 41RT109, 41RT110, 41RT111, 41RT112, 41RT113, 41RT114, 41RT115, 41RT116, 41RT117, 41RT118, 41RT119, 41RT120, 41RT121, 41RT122, 41RT123, 41RT124, and 41RT125. These sites generally consisted of lithic scatters and associated cultural deposits of varying depths usually located on sandy knolls near permanent water. The historic site is 41RT126 and consists of a log structure built about 1840 with hand-hewn logs and square nails. Avoidance or preservation was recommended for this site (Turpin and Kluge 1980). The eight prehistoric sites listed in Table 6-32 were considered sufficiently intact and warranted further testing to determine their eligibility to the National Register of Historic Places (Turpin and Kluge 1980). To date, these sites have not been tested and no other proposed mining areas have been surveyed. In addition, three cemeteries (Nesbitt, Pace, and Head cemeteries) are in the boundaries of the proposed mining leases. One of the graves in the Head cemetery, that of James Alfred Head, is a Texas State Historical Landmark. Another State Historical Landmark, the Potter Shop, is 12 miles east of Thornton on FM 1246 in Limestone County and may be in one of the leases.

6.7.2 Environmental Consequences From the No Action Alternative

Since no significant cultural sites were located in the Twin Oak project site, the no action alternative will have no direct effect on cultural resources. Disturbance to date due to past clearing and construction also has not affected cultural resources.

6.7.3 Environmental Consequences From the Construction and Operation of the Proposed Project

6.7.3.1 TOSES and Associated Facilities

Necessary surveys of the TOSES site have been completed, and all sites recommended for testing have been tested, each resulting in negative findings. No other sites have been identified that will require further (more detailed)

Table 6-32. Sites recommended for subsurface testing in the TOSES project area.

Site Number	Comments
41RT107	The depth of sandy sediments at this site exceeds 60 cm. Although surficially disturbed, undisrupted depositional sequences may be retained at depth.
41RT109	Cultural material, exposed by shovel probes, is a minimum of 40 cm deep although not surficially evident. Thses buried deposits may be relatively intact.
41RT111	This site has been exposed by plowing. The location is highly favorable for prehistoric occupation. The depth and extent of this site should be further tested.
41RT113	This site is the largest located during the course of the survey. The sandy sediments are at least 1 m deep; archaeological deposits below the plow zone may have resisted major disruption.
41RT114	Cultural material exposed at this site exceeds that of all others recorded during this survey in both quantity and variety. The wooded section of the site holds promise for intact deposits.
41RT115	The proximity of this site to 41RT113 and 41RT114 permits economic testing to evaluate the relationship between them. Sandy sediments here are at least 1 m deep.
41RT116	A portion of this site is densely wooded. Deposits in that portion of the site may remain intact.
41RT118	Dense woods still stand on the southwestern perimeter of the exposed cultural material. It is very possible that archaeological deposits have remained undisturbed beneath this wooded area.

Source: Turpin, S. A., and M. J. Kiuge. 1980. Cultural resource sampling survey and assessment in areas to be affected by the Twin Oaks Steam Electric Generating Station, Robertson County, Texas. Texas Archeological Survey. Research Report No. 72.

investigation. The construction of the plant will have no adverse effects on any sites included in or eligible for inclusion in the National Register of Historic Places. EPA's determination of "no effect" has been confirmed by the Texas Historical Commission (see Appendix A).

6.7.3.2 Transport Systems

All transport facilities (makeup water pipeline, railroad spur, and power transmission facilities) have been surveyed, and compliance with Section 106 of the National Historic Preservation Act accomplished. EPA has determined that no effect to cultural resources will result. The Texas Historical Commission has concurred with this no effect determination. (see Appendix A).

6.7.3.3 Mine

The one investigation of the mine sites that has been done identified eight sites (Table 6-32) that were considered sufficiently intact and warranted further testing to determine their eligibility to the National Register of Historic Places (Turpin and Kluge 1980). In addition, avoidance or preservation was recommended for a historic log structure, 41RT126, that is located on the mining sites. The results of this preliminary survey did identify the potential for encountering significant cultural resources in the areas to be mined. If further investigations are not conducted, mining activities will result in an irreparable loss of these resources. The Texas Railroad Commission in consultation with the Texas Historical Commission should ensure that these investigations are completed and cultural resources protected prior to issuance of a mining permit.

6.8 SOCIOECONOMIC RESOURCES

6.8.1 Existing Conditions

6.8.1.1 Demographic Characteristics

Fourteen incorporated communities and approximately 19 unincorporated communities are located in the project area (Figure 6-16). Communities with populations larger than 5,000 people include Marlin, Mexia, and Hearne.

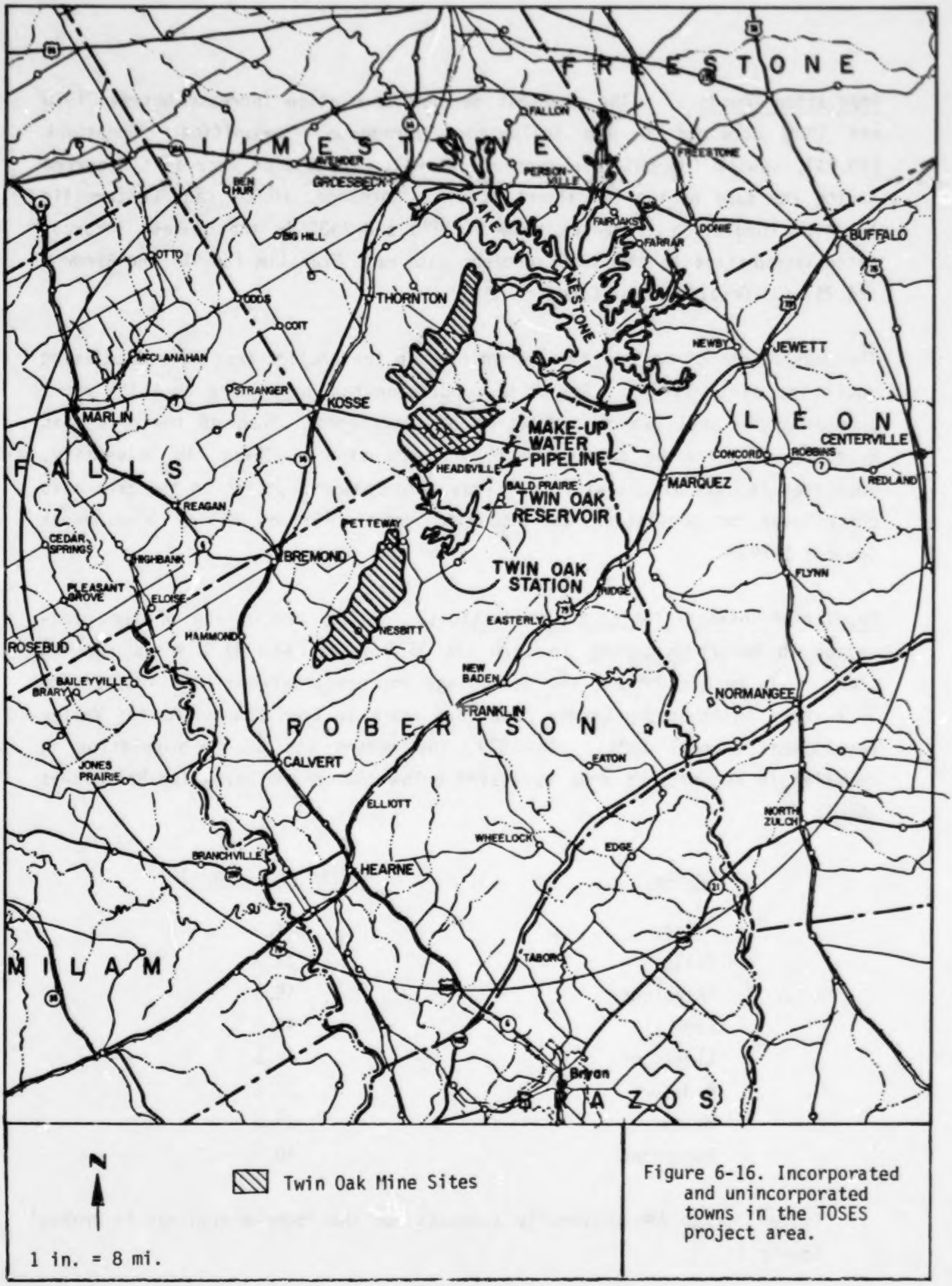
FREESTONE
LIMESTONE
FALLON
FREESTONE
LAVENDER
BEN HUR
GROESBECK
PERSONVILLE
LAKE LIMESTONE
FAIROAKS
DONIE
FARRAR
BUFFALO
BIG HILL
OTTO
THORNTON
ODDS
COIT
NEWBY
JEWETT
MCCLANAHAN
STRANGER
KOSSE
MARLIN
LEON
CENTERVILLE
MAKE-UP WATER PIPELINE
CONCORD
ROBBINS
FALLS
HEADSVILLE
BALD PRAIRIE
TWIN OAK RESERVOIR
MARQUEZ
REDLAND
REAGAN
PETTEWAY
CEDAR SPRINGS
HIGHBANK
BREMOND
TWIN OAK STATION
RIDGE
FLYNN
PLEASANT GROVE
ELOISE
EASTERLY
HAMMOND
NESBITT
ROSEBUD
NEW BADEN
BAILEYVILLE
BRARY
NORMANGEE
FRANKLIN
ROBERTSON
CALVERT
EATON
JONES PRAIRIE
ELLIOTT
NORTH ZULCH
WHEELOCK
EDGE
BRANCHVILLE
HEARNE
MILAM
TABOR
Bryan
BRAZOS
N
▨ Twin Oak Mine Sites
1 in. = 8 mi.

Figure 6-16. Incorporated and unincorporated towns in the TOSES project area.

Population Trends. The greatest percent population increase between 1970 and 1980 occurred in the following incorporated communities: Groesbeck (40.8%), Jewett (33.6%), and Rosebud (30.0%). Population decreases occurred during the same period in Calvert (16.4%), Normangee (6.9%), and Centerville (3.9%). Population increases between 1970 and 1980 in the closest incorporated communities to the TOSES project site were Franklin (26.9%) and Bremond (24.7%) (US Department of Commerce 1981).

The populations of most of the communities in the project area were decreasing until the early 1970's. The urban population has grown more than the rural population in areas where population has increased. Much of the growth in Brazos County can be attributed to the expansion of Texas A&M University. Increased industrial activity, oil, gas, and coal production in the area also contributed to population and economic growth (Brazos Valley Development Council 1979).

Population Characteristics and Projections. The median age of the population in Robertson County in 1970 was 35.8 years, and 41.9 years in Leon County. In both counties, the median age increased between 1970 and 1976 to 37.6 years in Robertson County, and 43.6 years in Leon County (Brazos Valley Development Council 1979). In 1979, the median age of the population in counties in the project area is listed below (Sales and Marketing Management 1980):

County	Median Age (Years)
Brazos	24.5
Falls	43.7
Freestone	45.8
Leon	45.3
Limestone	42.6
Madison	27.6
Milam	39.6
Robertson	38.3

(Note: Texas A&M University accounts for the lower median age in Brazos County.)

Population projections through the year 2000 were developed by the TDWR for counties in the project area and are presented in Table 6-33. Data relating population projections prepared by the Brazos Valley Development Council in 1979 for Brazos, Leon, and Robertson Counties show significantly higher populations in Brazos County and Robertson County, and slightly lower projections in Leon County. Recent population projections by the Central Texas Council of Governments for Milam County are higher than projections by the TDWR (By letter, Jennifer L. Wegley, 6 October 1981).

6.8.1.2 Economic Activity and Trends

The status of the existing economy in the project area can be judged by the extent and type of employment, income characteristics, and local governmental finances of the area. These factors are the most likely to be affected by the Twin Oak project.

Labor Force. Both total employment and employment rates are indicators of the available labor force throughout the course of the project. The unemployment statistics for communities in the project area are included in Table 6-34. In all cases, the unemployment rate decreased overall between 1976 and 1980, as it has in Texas as a whole. The unemployment rate in Falls County was the only rate that was routinely above the State unemployment rate. The strongest overall decrease in the unemployment rate and total unemployed since 1976 occurred in Madison County.

Employment Characteristics. The economy of the project area is based primarily on agriculture, with ranching being a major agricultural activity. General American Transportation Corporation in Hearne is a leading employer in manufacturing (Southwest Research Institute 1980). The lowest unemployment rate in 1980 was 3.2% in Limestone County, while the highest rate, 5.8%, was in Robertson County. Robertson County was the only county in 1980 with an unemployment rate above the State unemployment rate of 5.2%.

Income Characteristics. Total personal income increased throughout the project area between 1959 and 1978, but per capita income remained below the US average.

Table 6-33. Population projections for counties in the TOSES project area.

County	1980	1985	1990	1995	2000
Brazos	79,300	85,700	93,100	102,200	112,700
Falls	17,000	16,600	16,100	15,800	15,500
Freestone	13,100	13,600	14,400	15,400	16,600
Leon	9,200	9,400	9,700	9,900	10,200
Limestone	18,400	18,500	18,600	18,700	18,800
Milam	20,600	20,700	20,900	21,300	21,900
Robertson	14,900	15,000	15,100	15,400	15,900

Source: Texas Department of Water Resources. 1980a. Population projections for Texas, state, county, state planning region, and 208 water quality designated areas. Austin TX, variously paged.

Table 6-34. Total unemployed and unemployment rates in the TOSES project area (1976 - 1980 annual averages).

County	1976	1977	1978	1979	1980
Brazos					
Unemployed	1,185	1,206	1,109	1,027	1,455
Rate	3.6	3.4	3.0	2.6	3.5
Falls					
Unemployed	472	444	479	388	396
Rate	5.8	5.5	5.9	5.0	5.1
Freestone					
Unemployed	221	201	177	133	164
Rate	5.1	4.6	3.8	2.9	3.4
Leon					
Unemployed	245	208	176	143	170
Rate	6.2	4.8	4.2	3.4	4.0
Limestone					
Unemployed	263	295	366	217	261
Rate	3.4	3.7	4.6	2.8	3.2
Milam					
Unemployed	304	251	323	247	315
Rate	3.8	3.0	3.8	2.9	3.6
Robertson					
Unemployed	324	294	268	244	321
Rate	6.0	5.4	4.7	4.4	5.8
State					
Unemployed	320,000	309,000	289,017	263,000	336,500
Rate	5.7	5.4	4.8	4.2	5.2

Source: Texas Employment Commission. 1981. Labor force estimates for Texas counties - annual average 1976-1980. Austin TX, variously paged.

Median household effective buying income (EBI) is an indicator of the effective buying income of families. In 1979, the median household EBI for Texas was $21,501. It is projected that the State median household EBI will increase to $35,340 by 1984. The 1979 indexes for counties in the project area range from $7,602 in Robertson County to $20,357 in Brazos County. The EBI for most households in the project area fall in the $15,000 to $24,000 range, whereas, most households in the State have EBI's greater than $25,000. All counties in the project area had a higher percentage of households in the lowest EBI range ($8,000 to $9,999) than the State (Sales and Marketing Management 1980).

Local Government Finances. Countywide data on revenues, tax structures, and expenditures in 1972 are included in Table 6-35. The general revenues in Brazos County, which includes the urban area of Bryan/College Station, far exceeded the revenues of Milam County, were the next highest total revenues in the project area. The lowest total general revenues occurred in Leon County. Federal intergovernmental transfers were responsible for the higher percent of total revenues in Brazos County. The smallest amount of Federal revenue transfers occurred in Robertson County and Leon County . All counties in the project area received less than the statewide percent (13.4%) of Federal transfers. In all counties except Brazos County, total tax revenues were less than $2 million. The State average per capita property tax rate far exceeds the rate in the project area. Per capita expenditures (excluding capital outlay) in Freestone County were higher than any other county in the project area, but significantly lower than the State average.

6.8.1.3 Housing

Availability. The project area is primarily rural, and the majority of new housing units are mobile homes. These units often are relocated by their owners rather than sold in-place to newcomers to the area. A large percent of the occupied housing units occurring in Leon County and Robertson County were substandard (Brazos Valley Development Council 1979). Although housing is plentiful in Bryan and College Station, housing in the more rural areas is extremely scarce (By phone, Laura Kresel, Brazos Valley Development Council, 29 October 1981). Data relating projections of housing units needed in 1987,

Table 6-35. Local government finances in the TOSES project area (1972).

	GENERAL REVENUES					EXPENDITURES	
		Intergovernmental		Taxes			
County	Total (Million $)	Total (Million $)	Federal (%)	Total (Million $)	Property ($ Per Capita)	Total (Million $)	Per Capita[1] ($)
Brazos	15.8	6.1	9.6	6.3	89	16.1	238
Falls	3.7	1.8	6.1	1.3	59	4.3	184
Freestone	3.5	1.6	6.8	1.1	84	4.5	309
Leon	2.7	1.4	3.5	1.0	101	2.5	266
Limestone	4.4	2.0	3.8	1.8	80	6.0	219
Milam	4.6	2.1	4.2	2.0	81	4.5	212
Robertson	3.6	1.8	3.5	1.1	61	4.4	246
State	4231.0	1275.0	13.4	1972.0	153	4544.0	325

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[1] Excluding Capital Outlay

Source: US Department of Commerce. 1977. County and city data book.
Bureau of the Census, Washington DC, 956 p.

not including the needs attributable to the Twin Oak project, are presented in Table 6-36. In all counties except Leon County, the number of housing units increased more rapidly between 1970 and 1980 than the population increased during the same period. This was due primarily to a decrease in average family size.

A steady increase in demand for housing has occurred recently in Robertson County (Caddel 1981). An active building and development climate exists in Franklin, the closest incorporated community to the TOSES project site. In addition to plans for a grocery/department store and a new school, plans are underway for a multifamily/single family development in the vicinity. In general, high interest rates in recent years has limited new construction of housing units.

6.8.1.4 Community Facilities

Municipal Water and Wastewater Treatment. Water shortages occur in most of the communities in the project area. The most severe shortage of municipal drinking water is in Hearne. The communities of Franklin, Calvert, and Rosebud also face potential shortages in the future if the demand for water increases. People in the communities of Franklin and Rosebud already rely partly on water storage capacity. Communities not served by private wells are served by rural water systems. Growth in Brazos, Leon, and Robertson Counties is currently limited due to inadequate water distribution systems (Brazos Valley Development Council 1979).

Municipal wastewater treatment facilities exist in all incorporated communities in the project area except Marquez and Normangee. The permitted capacity of wastewater treatment plants in Centerville, Franklin, and Calvert is frequently exceeded. The facilities in Bremond and Hearne operate at or occasionally over permitted capacity, and the Groesbeck plant is nearing capacity operation (Texas Department of Health 1980). A new treatment plant is being built in Calvert and is near completion, and a feasibility study for a new treatment facility is being prepared for Franklin.

Table 6-36. Projected cumulative housing units needed in the project area in 1987 without the TOSES project.

County	Cumulative Housing Units Needed
Brazos	34,267
Falls	--
Freestone	4,594
Leon	1,736
Limestone	--
Milam	--
Robertson	4,132

Source: Texas Departemnt of Community Affairs. 1978. Housing model analysis. Austin TX, variously paged.

Medical Services. Statistics on the capacity and utilization of hospital beds in the project area are presented in Table 6-37. In general, there is a shortage of doctors in the project area and hospital services are not available in all communities. However, general hospitals in the project area operate well below capacity.

Education. The lowest ratio (6.58) of teachers to students (per 100 average daily attendance) in the project area occurred in Normangee. Public school attendance and teaching staff data are included in Table 6-38. Franklin Independent School District voters recently approved a bond election to build a new junior high and high school. Additional school age children expected in Freestone County may also necessitate expansion of school facilities (Texas Department of Community Affairs, County and Rural Services Division 1978). Adequate education facilities exist in Brazos County.

Police and Firefighting Services. Data relating to the level of police and fire protection provided in the incorporated communities of the project area are also presented in Table 6-38. Many of the smaller communities have no police departments and rely on county law enforcement agencies. All communities are served by some type of fire fighting capability, whether paid or volunteer.

Solid Waste Management Services. Landfills with additional solid waste disposal capacity exist in Bremond, Calvert, and Hearne. The Franklin landfill is already beyond its design capacity. Although Bremond's landfill has available capacity through 1990 at current disposal rates, the city has no solid waste collection service. A list of existing or proposed landfills in the project area, and the permit status of each is included in Table 6-39.

6.8.2 Environmental Consequences From the No Action Alternative

If the TOSES is not developed on the project site, the socioeconomic growth projected during the early 1980's will not proceed as rapidly or to the extent described in Section 6.8.3. The socioeconomic environment of the project area, however, likely will change significantly during the mid-to-late 1980's as other energy developments stimulate the economy and the area experiences new growth.

Table 6-37. Availability of hospital beds in the TOSES project area.

City	Patient-Days Year	Average Bed Needs Per Day	Available Beds (Set-Up Capacity)	Reserve (Percent)
General Hospitals				
Hearne	5,542	15	30	100
Marlin	58,160	159	244	35
Rosebud	9,266	25	38	52
Buffalo	3,304	9	32	256
Groesbeck	5,360	15	38	153
Long-Term Care				
Calvert	11,423	31	32	3
Hearne	43,358	119	148	24
Marlin	84,407	231	237	3
Buffalo	18,126	50	60	20
Groesbeck	26,941	74	79	7
Rosebud	40,857	112	124	11
Tuberculosis				
Marlin	6,332	17	20	18

Source: Texas Department of Health. 1978. Texas medical facilities inventory and utilization calendar year 1977. Austin TX, 503 p.

Table 6-38. Paid police, firemen, and teachers in the 14 incorporated communities in the project area.[a]

City	No. of Paid Policemen	No. of Paid Firemen[b]	No. of Paid Teachers	Average Daily Student Attendance (ADA)	Teachers Per 100 ADA[c]
Marlin	6	13	136	1,781	7.64
Rosebud	2	0	65	932	7.97
Jewett	0	0	30	422	7.11
Marquez	0	0	With Jewett	With Jewett	-
Centerville	0	0	40	418	9.57
Normangee	0	0	25	380	6.58
Buffalo	1	10	35	516	6.78
Groesbeck	4.5	0	60	940	6.38
Thornton	0	0	With Groesbeck	With Groesbeck	-
Kosse	0.5	0	With Groesbeck	With Groesbeck	-
Bremond	1	0	25	287	8.71
Franklin	1	0	40	540	7.41
Calvert	4.5	0	35	423	8.10
Hearne	6	0	109	1,619	6.73

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[a] Part-time employees are valued as one-half paid employees in totals.

[b] All communities are served by either paid or volunteer departments.

[c] Where more than one city is served by one school district, teachers per ADA is recorded for one city.

Source: Texas Education Agency. 1979. 1979-1980 superintendents annual report. Austin TX, 38 p.

Table 6-39. Sanitary landfill solid waste permit status in the TOSES project area (1980).

Landfill Locations	Status
Bremond	B
Buffalo	P,R,A
Calvert	I
Centerville	P
Franklin	R,R,I
Groesbeck	I
Hearne	I,I
Jewett	B
Marlin	I
Normangee	R,I,B
Rosebud	I

A - Part "A" of Application Filed
B - Part "B" of Application Filed
D - Permit Denied
I - Permit Issued
P - Pre-Application
R - Additional Information Requested

Source: Texas Department of Health. 1980. Management information system permit application file as of 18 December 1980. Division of Solid Waste Management. Austin TX, 106 p.

6.8.3 Environmental Consequences From the Construction and Operation of the Proposed Projects

In general the effects on the socioeconomic environment from the Twin Oak power plant and mine are very similar and therefore are combined for presentation. Additionally, data relative to transport systems were not available as a separate entity, but were combined with the TOSES. From 1982 to 1986, most of the effects will be attributable to the TOSES. However, in later years (1986-on) the mine will have an equal or greater influence on the socioeconomic environment of the project area.

The area of influence (project area) has been expanded from the 30-mile radius used for the other sections in Chapter 6 to a 50-mile radius. The 50-mile radius is used to determine socioeconomic effects because it is assumed that the construction and operation workers will live within 1 hour commuting time (50 miles) of the Twin Oak project site, therefore the effects will be evident within the 50-mile radius.

6.8.3.1 Population

Population Influx. Peak employment is estimated to reach 1,619 persons by 1987 (TUSI 1981b). This figure includes 1,000 construction workers at the TOSES, 150 construction workers at the mine, 234 operation workers at the TOSES, and 235 operation workers at the mine (Table 6-40). The numbers of construction workers and operation workers projected for the power plant and the mine and the estimated induced population during the peak construction year (1987) are included in Table 6-40 and Figure 6-17. The maximum increase of induced population during the peak construction phase (1987) is projected to be 3,010. In addition to the actual employees, this number includes the induced service sector employment and the workers' families. The power plant workers and the mine workers are included together to provide a more comprehensive analysis of the social and economic impacts of the project. During the operation phase of the TOSES and mines (1996-2016), the maximum induced population is estimated to reach 1,491 persons (Figure 6-18).

Table 6-40. Personnel requirements for construction and operation of the proposed TOSES, associated transport facilities, and the associated Twin Oak Mine.

	Power Plant Requirements			Mine Requirements		
Year	Construction Personnel	Operation Personnel	TOTAL	Construction Personnel	Operation Personnel	TOTAL
1982						
1983						
1984	350		350	75		75
1985	600	13	613	150	5	155
1986	1000	81	1081	100	34	134
1987	1000	234	1234	150	235	385
1988	600	312	912	150	415	565
1989	500	353	853	100	464	564
1990	200	353	553	50	596	646
1991					596	596
1992					628	628
1993					734	734
1994					936	936
1995					971	971
1996-2018					971	971

Source: Adapted from Texas Utilities Services, Inc. (1980). Environmental Information Document for Twin Oak Steam Electric Station, Robertson County, Texas. Dallas, TX, variously paged.

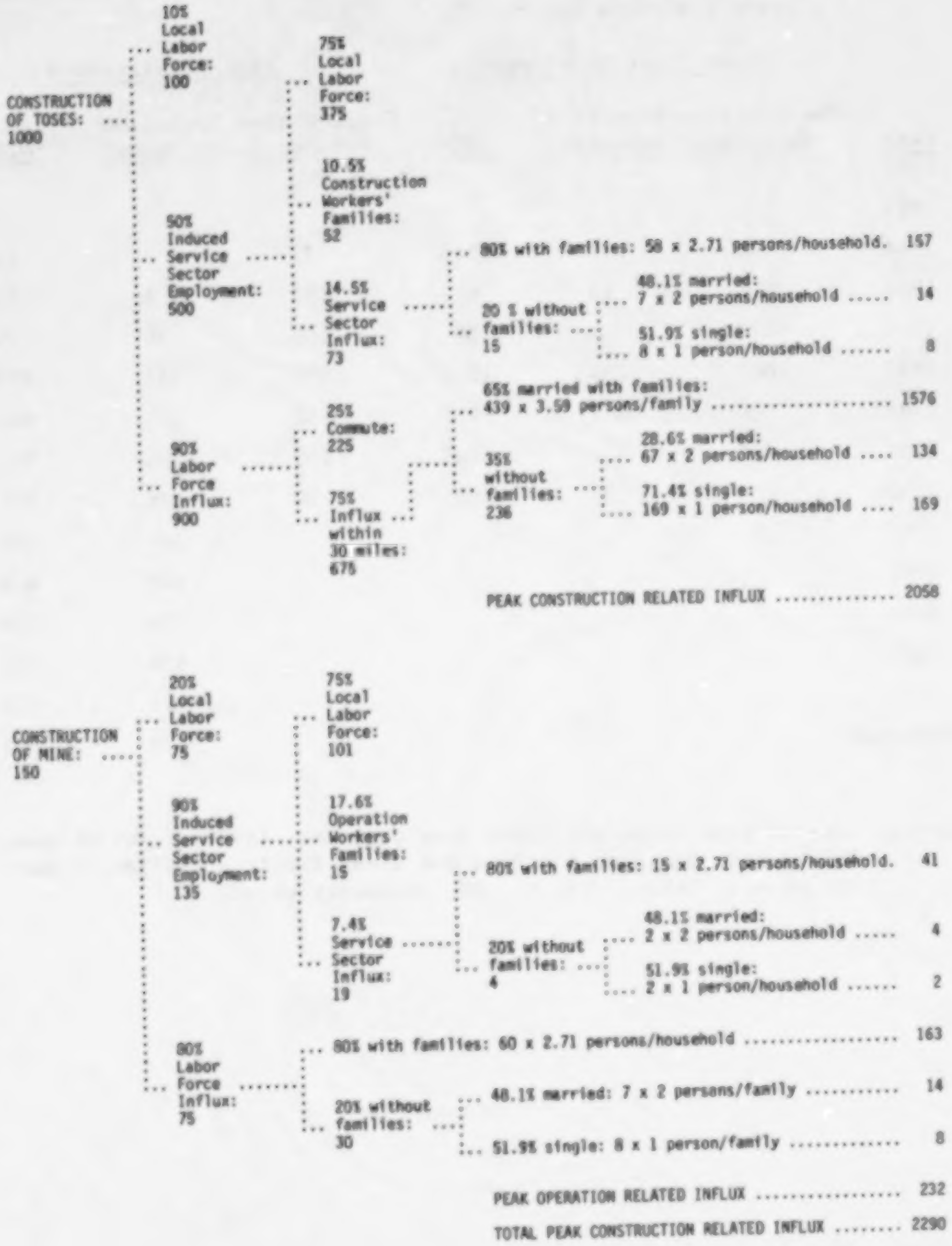

CONSTRUCTION OF TOSES: 1000
10% Local Labor Force: 100
75% Local Labor Force: 375
10.5% Construction Workers' Families: 52
50% Induced Service Sector Employment: 500
80% with families: 58 x 2.71 persons/household. 157
14.5% Service Sector Influx: 73
48.1% married: 7 x 2 persons/household 14
20 % without families: 15
51.9% single: 8 x 1 person/household 8
65% married with families: 439 x 3.59 persons/family 1576
25% Commute: 225
28.6% married: 67 x 2 persons/household 134
90% Labor Force Influx: 900
35% without families: 236
75% Influx within 30 miles: 675
71.4% single: 169 x 1 person/household 169
PEAK CONSTRUCTION RELATED INFLUX 2058
CONSTRUCTION OF MINE: 150
20% Local Labor Force: 75
75% Local Labor Force: 101
90% Induced Service Sector Employment: 135
17.6% Operation Workers' Families: 15
80% with families: 15 x 2.71 persons/household. 41
7.4% Service Sector Influx: 19
48.1% married: 2 x 2 persons/household 4
20% without families: 4
51.9% single: 2 x 1 person/household 2
80% with families: 60 x 2.71 persons/household 163
80% Labor Force Influx: 75
48.1% married: 7 x 2 persons/family 14
20% without families: 30
51.9% single: 8 x 1 person/family 8
PEAK OPERATION RELATED INFLUX 232
TOTAL PEAK CONSTRUCTION RELATED INFLUX 2290

Figure 6-17. Estimated population influx during peak construction year (1987) for the proposed Twin Oak projects.

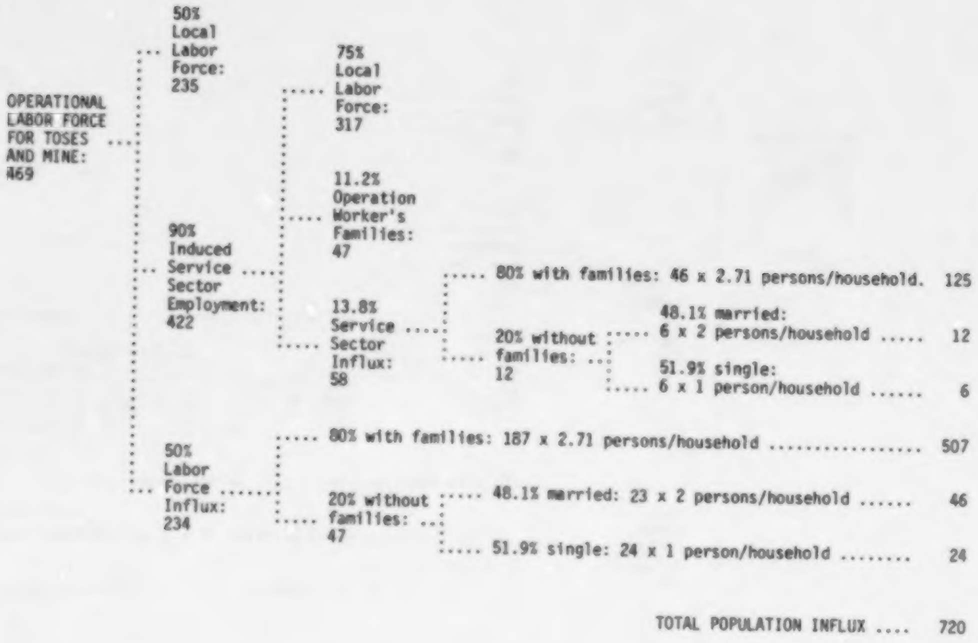

OPERATIONAL LABOR FORCE FOR TOSES AND MINE: 469
50% Local Labor Force: 235
90% Induced Service Sector Employment: 422
75% Local Labor Force: 317
11.2% Operation Worker's Families: 47
13.8% Service Sector Influx: 58
80% with families: 46 x 2.71 persons/household. 125
20% without families: 12
48.1% married: 6 x 2 persons/household 12
51.9% single: 6 x 1 person/household 6
50% Labor Force Influx: 234
80% with families: 187 x 2.71 persons/household 507
20% without families: 47
48.1% married: 23 x 2 persons/household 46
51.9% single: 24 x 1 person/household 24
TOTAL POPULATION INFLUX 720

Figure 6-17. Estimated population influx during peak construction (1987) for the proposed Twin Oak projects (concluded).

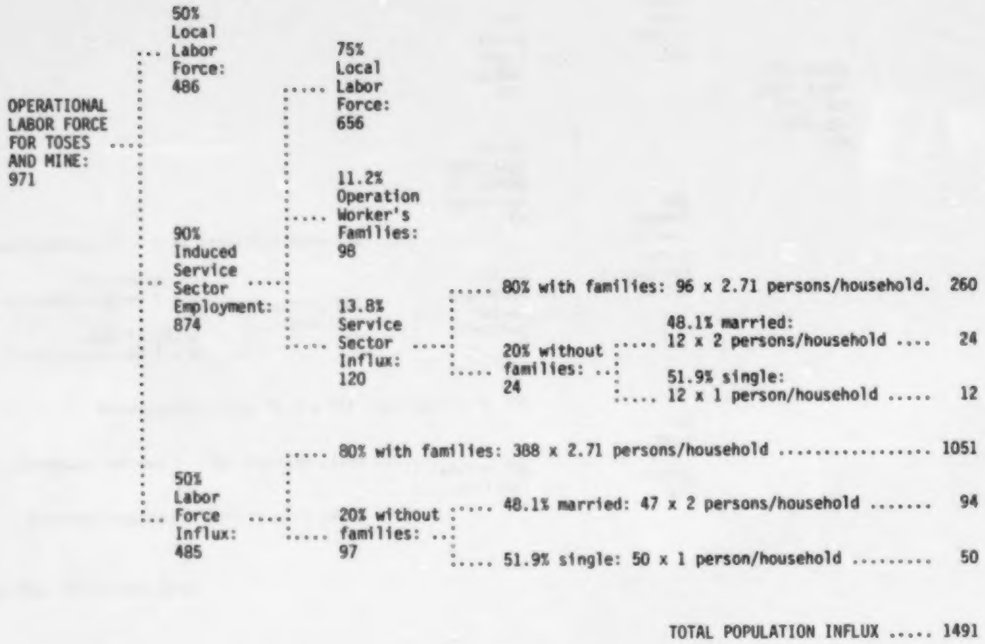

OPERATIONAL LABOR FORCE FOR TOSES AND MINE: 971
50% Local Labor Force: 486
90% Induced Service Sector Employment: 874
50% Labor Force Influx: 485
75% Local Labor Force: 656
11.2% Operation Worker's Families: 98
13.8% Service Sector Influx: 120
80% with families: 96 x 2.71 persons/household. 260
20% without families: 24
48.1% married: 12 x 2 persons/household 24
51.9% single: 12 x 1 person/household 12
80% with families: 388 x 2.71 persons/household 1051
20% without families: 97
48.1% married: 47 x 2 persons/household 94
51.9% single: 50 x 1 person/household 50
TOTAL POPULATION INFLUX 1491

Figure 6-18. Estimated population influx during operation of the proposed Twin Oak projects (1996-2018).

Distribution of the induced population among fourteen population centers in a 50-mile radius of the Twin Oak project site was determined by using a method developed by Mountain West Research, Inc. (1976). Three major cities Bryan-College Station, Waco, and Temple, are expected to receive 80% of the population influx for both the construction and operation phases (Table 6-41). The potential percent increase in population for cities and towns (presented in Table 6-41) ranges from 0.95% to 3.35% during the construction phase of the projects and from 0.47% to 1.67% during the operation of the project.

Characteristics. In a survey conducted by the Old West Regional Commission, newcomer construction workers and other newcomers had a median age of approximately 22 years. The median age of the population in the seven counties nearest the project area was 34 years. However, if Brazos County (location of Texas A&M University) is excluded the median age of the population is 42 years. The introduction of a younger population, along with their ideas and lifestyles, could influence changes in communities in the Twin Oak project area. The population influx (% change) into any one community is estimated to be minimal, and the resulting adverse effects, insignificant.

6.8.3.2 Employment

A total of 1,619 direct employment opportunities will be generated at the peak level in 1987 by the construction and operation of the Twin Oak projects. This projection includes 1,234 employment opportunities solely for the TOSES (Table 6-40). The operation and maintenance force will reach a permanent level of 971 people beginning in about 1996.

During the peak year for construction (1987), 10% of the construction workers for the TOSES and the mine (175 persons) are anticipated to come from the local labor force existing in the seven surrounding counties. The additional 975 construction workers will move into the surrounding counties temporarily, or commute into the project area.

Fifty percent of the permanent labor force (486 workers) for the operation and maintenance of the TOSES from 1996 to 2016 will be supplied locally. The labor force influx (including the remaining 485 workers associated with

Table 6-41. Estimated distribution of population influx in population centers surrounding Twin Oak projects.

Population Center	1976 Population Estimates (a)	Distance From Project Site (b)	Distribution Indicator (c)	Distribution Factor (d)	(1987) Peak Construction Population Influx	Percentage of 1976 Population	(1996-2018) Operation Population Influx	Percentage of 1976 Population
Bremond	823	13	93.3	0.0086	26	3.16	13	1.57
Marquez	223	15	22.4	0.0021	6	2.69	3	1.35
Franklin	1,375	12	166.8	0.0153	46	3.35	23	1.67
Calvert	1,714	20	134.7	0.0124	37	2.16	18	1.05
Hearne	5,054	25	328.7	0.0302	91	1.80	45	0.89
Marlin	6,114	27	372.5	0.0343	103	1.68	51	0.83
Groesbeck	2,611	24	175.8	0.0162	49	1.87	24	0.91
Mexia	6,005	35	293.5	0.0270	81	1.35	40	0.67
Buffalo	1,255	32	66.2	0.0061	18	1.43	9	0.72
Centerville	805	30	44.8	0.0041	12	1.49	6	0.75
Madisonville	2,818	40	123.0	0.0113	34	1.21	17	0.60
Cameron	5,367	40	234.2	0.0215	65	1.21	32	0.59
Fairfield	2,797	42	117.1	0.0108	33	1.18	16	0.57
Bryan & College Station	77,400	37	3,608.6	0.3320	999	1.29	495	0.64
Waco	103,374	50	3,732.4	0.3434	1,034	1.00	513	0.49
Temple	39,473	53	1,356.4	0.1248	376	0.95	186	0.47
					3,010		1,491	

$c = \frac{a}{(b)^{0.849}}$

$d = \frac{c}{\sum c}$

operation) will be permanent in contrast with the temporary labor influx during construction.

Induced Employment. Income and spending will increase in the project area as a result of the influx of workers for the projects. Increased economic activity induces additional job opportunities. There will be 1,057 induced secondary employment opportunities in the project area during the 1987 peak construction period. Approximately 75% (793) of these jobs will be filled by the existing local labor force. Approximately 11% of the secondary induced jobs will be filled by the members of construction worker families that are new to the area, and the remaining positions will result in an additional influx of workers.

During the TOSES operation and mining, secondary induced employment opportunities will generate 874 new positions, or 47% of all new employment opportunities for the operation phase of the project. Of these 810 induced jobs, 75% (656) are expected to be filled by the local labor force; 11% (98) are expected to be filled by members of the new workers families; and only 14% (120) by workers who migrate into the seven county area as a result of expanding economic activity.

The difference between the number of jobs created during construction and those created as a result of the long-term operation and maintenance of the projects is the resulting temporary employment opportunities. Approximately 830 temporary jobs are anticipated during peak construction in 1987. Approximately 50% (1,090) of these temporary employment opportunities will occur due to the construction of the TOSES or mine. The remaining jobs will be distributed throughout the economy of the service, wholesale and retail trade, transportation, and government sectors.

Distribution of Employment by Sector. Long-term employment is projected to be distributed among the following sectors: construction, service, transportation, utilities and communications, retail trade, and public service employment. The shift in economic activity from basic to non-basic that occurred between 1976 and 1979 may reverse itself as employment in the above sectors causes the transportation and utility sectors to once again produce goods and services that are generated by external demand. The decline from 1976 to 1979 in both service and government sector employment should reverse due to the projected increase in long-term employment. The changes in employment patterns resulting from the proposed projects reduce unemployment and allow low-income workers to move into higher paying jobs. Overall, the changes in the project area economy will, in turn, diversify the regional economy.

6.8.3.3 Income

Both the short-term and long-term increases in wages and disposable income will benefit the project area and regional economies. During 1987 (peak construction) the total annual payroll will amount to $40.5 million (1982 dollars), of which $28.35 million will be disposable income. The majority of this disposable income will be spent and invested directly in the economy of project area.

The total annual payroll for 1996 (beginning of operations and maintenance) is estimated to be $31.2 million (1982 dollars), of which an estimated $21.85 million (1982 dollars) will be disposable income.

6.8.3.4 Government Finances

Revenues. Impacts on government finances can only be addressed in general terms, since changes in property values, as affected by the projects, can only be speculative. In general, population increases during the peak construction phase increase government expenditures and strain services. Revenues from project activities and general economic development lag behind the increased expenditures induced by the project related population influx. Thus, over the short-term there may be a significant imbalance between local revenues and expenditures. However, this imbalance will be adjusted over time as the population influx levels off during the operation phase.

Land values generally increase during the operation and maintenance period and generate additional property taxes. Concurrently, the volume of sales increases and additional sales taxes are incurred. These sources of revenue help support the additional demand for services. Increases in population result in larger sums of Federal Reserve Sharing monies for each incorporated city.

Sales Taxes. Increases in sales tax revenues resulting from increased disposable income can be computed for all employment directly and indirectly induced from both the power plant and mine. The local sales tax revenue generated from disposable income spent on retail sales is projected to be $99,225 during the construction phase, and $76,500 during the operation phase.

Property Taxes. Property taxes generally have risen steadily since 1967 and may increase due to increased land values associated with the general economic development in the project area. Several factors have influenced this increase: the location of the residence vis-a-vis the project site; whether property values are reassessed and by how much; and whether or not the basis of assessment is increased for both property and school taxes. These factors also influence the value of commercial and industrial properties and thereby affect the tax revenues generated. The municipal tax rate of $1.50 per $100 can only be increased if the population of each incorporated city exceeds 5,000 people.

Land used for the projects will not be removed from the tax rolls. The private corporations involved will be taxed for all land and improvements. The improvements on the project site are anticipated to yield substantial tax increases over those paid over previous years. In addition, there will be increased revenues generated from lignite leases.

Expenditures. Generally, expenditures have increased in the project area. However, the per capita percent of general expenditures has remained fairly constant. This trend could continue depending on the increases in revenues and the concurrent increased demand for additional services. In several instances, expansion of community services will be required, but with no additional capital outlay. A few specific services are currently operating close to capacity, and are projected to exceed that capacity with the induced population influx. In these instances there will be a substantial lag between expenditures on new or expanded capital facilities and the generation of revenues to pay for the facilities.

Housing. Adequate housing will be one of the most difficult problems in the project area. Housing demand was estimated based on the assumption that every employee who moved into the area would require a separate dwelling unit. It also was assumed that construction workers will require housing for a short period of time. The short-term residency of the construction worker does not warrant the construction of a large number of permanent units. Using these assumptions, an estimated demand for 1,359 housing units will occur in 1987. By 1996, this demand for housing will have decreased to 605 units, a 55% decrease from 1984.

The projected distribution of housing demand in a 50-mile radius of the project site was determined using the same method used for distributing population influx (Table 6-42). The distribution of housing during the operating phases of the Twin Oak projects will not be as disruptive to the communities as the peak demand during the construction phase. The housing demand during the operating phases will be for a more permanent type of housing, and allow communities to better plan for and accommodate needed services.

6.8.3.5 Community Services and Facilities

Demands placed on community services and facilities by new residents in the project area during peak project construction will create more problems (1985) than during the operation phase. Peak construction demands are for one year, whereas, the demands during operation will be for approximately 35 years. Consequently, a community that can provide services during the operation phase, but not during the construction phase may be willing to tolerate inadequate services for a short period instead of spending large sums of capital to upgrade services. The relatively small percentage increase (Table 6-41) for each community reduces the probability that the demands on the community services will exceed capacity.

Table 6-42. Distribution of demand for additional housing units by community in a 50-mile radius of the TOSES project site.

Population Center	Distribution Factor	1987	1996
Bremond	0.0086	12	5
Marquez	0.0021	3	1
Franklin	0.0153	21	9
Calvert	0.0124	17	8
Hearne	0.0302	41	18
Marlin	0.0343	47	21
Groesbeck	0.0162	22	10
Mexia	0.0270	37	16
Buffalo	0.0061	8	4
Centerville	0.0041	6	2
Madisonville	0.0113	15	7
Cameron	0.0215	29	13
Fairfield	0.0108	15	7
Bryan and College Station	0.3320	451	201
Waco	0.3434	466	208
Temple	0.1243	169	75
	TOTALS:	1,359	605

6.9 LAND USE

6.9.1 Existing Conditions

The definitions of land use classifications used in this section primarily are from the Soil Conservation Service (SCS), the Texas Railroad Commission (TRC). and the US Geological Survey (USGS).

6.9.1.1 Project Area

The major land uses (as defined by TDWR) within 30 miles of the power plant are presented in Figure 6-19 and Table 6-43. Approximately 67% of the land use/land cover in the project area is agricultural land, which includes both cropland and pasture. Forest and rangeland comprise 26% and 6%, respectively. This information is based on 1973 and 1976 Landsat imagery and is categorized according to USGS Level I interpretation.

The agricultural land is primarily pasture, although there are a few areas containing row crops (peanuts and oats) in the project area. The majority of the forest has not been actively managed for timber and is used primarily as grazingland for cattle. The TRC would classify this land as grazingland, while the SCS classifies it as grazed forestland (by phone, Michael Bogard, Limestone County District Conservationist, 30 September 1981).

6.9.1.2 Project Site

The proposed site (3,393 acres) where the TOSES and associated facilities are being constructed is used exclusively for pastureland or rangeland. Approximately 30% (1,018 acres) of the site was forested (upland and riparian combined), however it was not actively managed for timber and therefore would not be classified as forestland by the TRC. No row crops were identified on the project site. A determination of prime farmland has not been made for the project site. Less than 1% of the project site was covered by water (TUSI 1980). The remainder of the project site (69%, 2,341 acres) was pastureland.

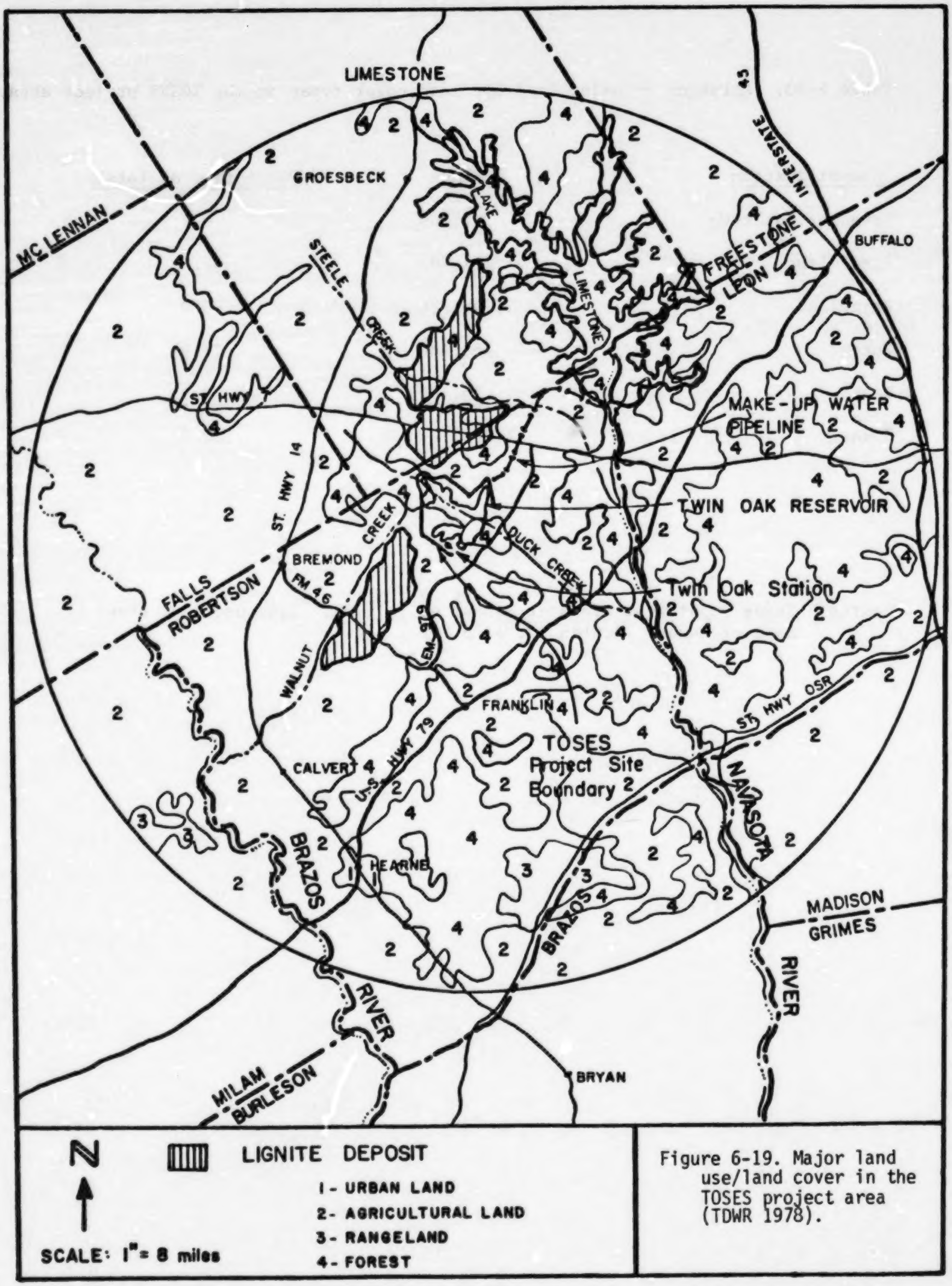

LIMESTONE
GROESBECK
MC LENNAN
STEELE CREEK
LAKE LIMESTONE
FREESTONE
LEON
INTERSTATE 45
BUFFALO
ST HWY
ST. HWY 14
MAKE-UP WATER PIPELINE
TWIN OAK RESERVOIR
Twin Oak Station
DUCK CREEK
CREEK
BREMOND
FM 46
FALLS
ROBERTSON
WALNUT
F.M. 979
FRANKLIN
ST HWY OSR
TOSES Project Site Boundary
CALVERT
U.S. HWY 79
NAVASOTA
HEARNE
BRAZOS
BRAZOS RIVER
MADISON
GRIMES
RIVER
MILAM
BURLESON
BRYAN
N
LIGNITE DEPOSIT
1 - URBAN LAND
2 - AGRICULTURAL LAND
3 - RANGELAND
4 - FOREST
SCALE: 1" = 8 miles

Figure 6-19. Major land use/land cover in the TOSES project area (TDWR 1978).

Table 6-43. Acreages of major land use/land cover types in the TOSES project area.

Classification	Acreage	Percentage of Total
Urban or Built-Up	4,109	0.2
Agricultural	1,211,795	67.0
Rangeland	109,786	6.0
Forest	468,630	25.9
Water	15,400	0.9
TOTAL	1,809,720	100.0

Source: Texas Department of Water Resources. 1978a. Land use/land cover maps of Texas. Austin TX, 47 p.

6.9.1.3 Transport Facility Sites

The land use along the transportation routes corresponds closely with the land use in the project area. The majority of the 822 acres along the railroad spur is in pastureland with some interspersed forest. The 109 acres contained in the make-up water pipeline corridor also are predominantly pasture. The 1,502 acres of new transmission line right-of-way are currently used for a variety of land uses, predominantly pasture.

6.9.1.4 Mine Site

The land use/land cover of the area to be mined (approximately 33,000 acres) is shown in Figure 6-19. This information is based on 1973 and 1976 Landsat imagery and is categorized according to Level I interpretation. Generally, the land of the mine site is used for grazingland and pastureland, but specific land uses are not known at this time (by phone, Larry Michel, TUSI, 14 January 1982). Further, there has been no determination of prime farmland on the mine sites. This determination will be made prior to obtaining a mine permit from the TRC.

6.9.1.5 Land Use Controls and Building Regulations

Community controls associated with land use and construction will help to regulate the induced growth that will result from the Twin Oak project. The ordinances for the communities in the project area that will receive the highest number of people are presented in Table 6-44. The smaller communities in the project area are less likely to have land use controls or building regulations. No areawide mechanism to regulate land use presently exists at the county or state level in Texas.

6.9.2 Environmental Consequences From the No Action Alternative

If the TOSES is not completed land use in the area in the short-term will continue as described in 6.9.1. The long-term land use patterns will continue to follow current trends. Some changes in land use have already resulted from construction that has taken place to date. Approximately 300 acres of pastureland and forest have been converted, and partial filling of Twin Oak

Table 6-44. Land use controls and building regulations for incorporated communities that will receive the most growth in the TOSES project area.

	Zoning Ordinances	Subdivision Regulations	Mobile Home Ordinances	Building Codes	Plumbing Codes	Electrical Codes
Brazos County						
Bryan[1]	N	Y	Y	Y	Y	Y
College Station[2]	Y	Y	Y	Y	Y	Y
Falls County						
Marlin[3]	Y	Y	Y	Y	Y	Y
Limestone County						
Groesbeck[4]	N	Y	N	Y	Y	Y
Robertson County						
Bremond[5]	N	N	Y	N	N	N
Franklin[6]	N	N*	N	Y	N*	Y
Hearne[7]	Y	N	Y	Y	Y	Y

Y - Yes
N - No

*A building permit is required but there is no code enforcement

Sources: 1) Miller, Cliff. 1982. Phone, Cliff Miller, Bryan Planning Department, to Dawn Davenport-Johnson, WAPORA, Inc., 25 January 1982.

2) Wilganowski, Verna and Coy Perry. 1982. Phone, Verna Wilganowski and Coy Perry, City of College Station, to Dawn Davenport-Johnson, WAPORA, Inc., 22 January 1982.

3) Foshee. 1982. Mr. Foshee, City of Marlin, to Dawn Davenport-Johnson, WAPORA, Inc., 22 January 1982.

4) Tilley, Martha. 1982. Martha Tilley, City of Groesbeck, to Dawn Davenport-Johnson, WAPORA, Inc., 22 January 1982.

5 Black, John C. 1982. John C. Black, City of Bremond, to Dawn Davenport-Johnson, WAPORA, Inc., 27 January 1982.

6) Smithers, Francis. 1982. Francis Smithers, City of Franklin, to Dawn Davenport-Johnson, WAPORA, Inc., 22 January 1982.

7) Hafley, Floyd T. 1982. Floyd Hafley, City of Hearne, to Dawn Davenport-Johnson, WAPORA, Inc., 22 January 1982.

Reservoir has occurred. Additional acreages have also been converted in the process of railroad and pipeline development.

Historically, there has been a trend toward converting cropland and forest to rangeland and pasture. In recent years, land conversion has slowed due to the state of the economy (by phone, Pink Ritter, Soil Conservation Service, 21 January 1982). Owing to the underlying lignite in this region of Texas, there has been and will continue to be an increase in coal exploration, mining, and electric energy production. For this reason, the trend toward the sale or leasing of land for the development of coal resources is expected to continue.

6.9.3 Environmental Consequences From Construction and Operation of the Proposed Project

6.9.3.1 TOSES and Associated Facilities

Construction of the TOSES will result in the conversion of approximately 3,393 acres of primarily pastureland and forest to long-term industrial use.

6.9.3.2 Transport Systems

Construction and operation of the railroad spur has permanently converted or disturbed 822 acres. Due to the relatively small acreage involved, the impacts are expected to be minor.

Construction of the make-up water pipeline has disturbed approximately 109 acres. The minor impacts to this area will be short-term in nature since the surface will be reclaimed to pasture. There should be minimal effect on the use of this land during the operation of the pipeline.

Construction of the transmission lines will temporarily disturb the land uses of the 3,089 acres. Existing rights-of-way will be utilized for approximately 1,587 acres. The existing rights-of-way have already been disturbed, therefore most impacts associated with the TOSES will take place on only the remaining 1,502 acres. After construction the land use of the rights-of-way should return to the preconstruction land use, with the exception occurring on forested land. The land in the transmission line right-of-way must be cleared of trees, therefore the only significant long-term impacts will occur in forested areas. Overall, the impacts on land use from the transmission lines are expected to be minimal.

6.9.3.3 Mine

Approximately 33,000 acres of primarily grazingland and pastureland will be converted temporarily to lignite mining through the life of the mine (approximately 35 years). Approximately 750 acres will be mined annually, and about 3,000 acres will be involved in the continuous process of surface mining, backfilling, and reclamation during a four to five year period. Reclamation will be conducted according to the surface coal mining regulations promulgated by the TRC with the specified purpose of returning the land to a condition as good as, or better than, that which preceded mining. Reclamation must begin within 180 days following coal removal (TRC 1981). The land use after reclamation is planned to be primarily pastureland with some shrubs and trees along fence rows and stock ponds. Although some of the land will be reclaimed with trees, there will be a net reduction in forested area.

It is uncertain what degree of maintenance will be required to sustain reclaimed land. Generally, the higher maintenance (e.g., fertilization, irrigation, and liming) that is required, the less likely it is that the area will be maintained after it is returned to the original landowners. If the landowners are unable to sustain the productivity of the reclaimed land, there could be a significant adverse impact to the land use of the mine area.

If there is any prime farmland as defined by TRC on the mine site it will be reclaimed according to the criteria specified in the surface coal mining regulations (Chapter 4, Subchapter K, Part 923) published by TRC on 1 January 1981. Soil that has the physical and chemical characteristics of prime farmland but has not been used for intensive agriculture purposes for 5 out of the previous 10 years is not required to be reclaimed by the same method as prime farmland soils on the mine site. Depending on the reclamation technique used, it is probable that this soil will not retain the prime farmland characteristics after reclamation.

6.10 RECREATION AND AESTHETICS

6.10.1 Existing Conditions

The setting of the project area is primarily rural with gently rolling hills, farmhouses, grazing livestock, and small streams and ponds interspersed with forested bottomlands.

The major recreation in the project area includes water related sports on Lake Limestone, Lake Mexia, the Navasota River, and Brazos River, as well as smaller streams, lakes, and ponds. Water related activities with greatest participation are fishing and boating. Hunting occurs as both land and water based recreation. There are numerous whitetail deer leases in the project area that result in some revenue for area landowners.

Fort Parker State Park and Old Fort Parker State Park are located in the project area between Mexia and Groesbeck in Limestone County. Presently the recreation on the Twin Oak project site probably consists of some hunting, although no known deer leases occur on the project site (by phone, Larry Michel, TUSI, 28 January 1982). Little is known about the recreational uses of the mine site. Probable recreational uses include hunting, fishing, horseback riding, and other recreation associated with rural living.

6.10.2 Environmental Consequences From the No Action Alternative

Coal exploration, mining, and coal related developments in the project area will continue to increase due to the presence of lignite. This will, and has, resulted in some reduction of areas suitable for hunting in the project area and on the project site. Water recreation, hunting, and fishing will continue to be the major recreational activities in the project area.

6.10.3 Environmental Consequences From Construction and Operation of the Proposed Project

6.10.3.1 TOSES and Associated Facilities

Construction of the TOSES will result in the conversion of 3,393 acres into long-term industrial use. Because of private agricultural enterprise and land ownership, the Twin Oak project site is not currently being used for major recreational purposes. Therefore the construction and operation of the TOSES will not have a significant effect on the recreation of the project site. However, the people that will enter the area to work on the TOSES, as well as support and services people that move to the area, may increase the recreation pressures on area lakes and open lands.

The construction of the TOSES will doubtless alter the aesthetics of the project site. Although subjective, a change from rural to industrial is generally considered an adverse aesthetic impact. At the same time, many people may consider a change from pastureland to lakeshore as a beneficial aesthetic impact.

6.10.3.2 Transport Systems

The construction and operation (maintenance) of the make-up water pipeline, power transmission lines, and railroad spur, will have a minimal effect on the recreation of the project area. Depending on the preference of the landowner, transmission line rights-of-way may increase the accessibility of an area for hunting or other recreational uses. Transmission facilities and the railroad spur will have a negative visual effect on the aesthetics of the project area, although individual preference dictates the degree to which their appearance is objectionable. After the construction of the pipeline there should be minimal further impact on the appearance of the area.

6.10.3.3 Mine

Hunting and other recreational opportunities will be lost on approximately 3,000 acres at any given time during mining. The proposed post-reclamation land use will reduce the amount of forest, and thereby reduce hunting and other forest related recreational opportunities. If the acreage of ponds increases after reclamation, then hunting, fishing, and other water related recreational opportunities associated with ponds may increase.

The actual process of surface mining will have an adverse effect on the aesthetics of the mine sites. After reclamation there will be a different composition and stratification of vegetative cover which will change the visual and physical appearance of the mine sites. Prompt successful reclamation can ensure there will not be a major negative effect on the visual appearance of the mined area.

6.11 TRANSPORTATION

6.11.1 Existing Conditions

Highways and railroads represent the major transportation facilities in the project area. Information on the number of interstate highways miles, state highway miles, and railroad miles for counties in the project area is included in Table 6-45.

6.11.1.1 Highways

Direct access to the TOSES project site will be provided by a road built by TUSI from Farm to Market (FM) 979. Roads from the nearby towns that lead into FM 979 are FM 46, FM 2293, State Highway (SH) 7, SH 6, and SH 14. The annual average 24-hour traffic volumes in vehicles per day on these roads as well as other roads in the project area are shown in Figure 6-20.

6.11.1.2 Railroads

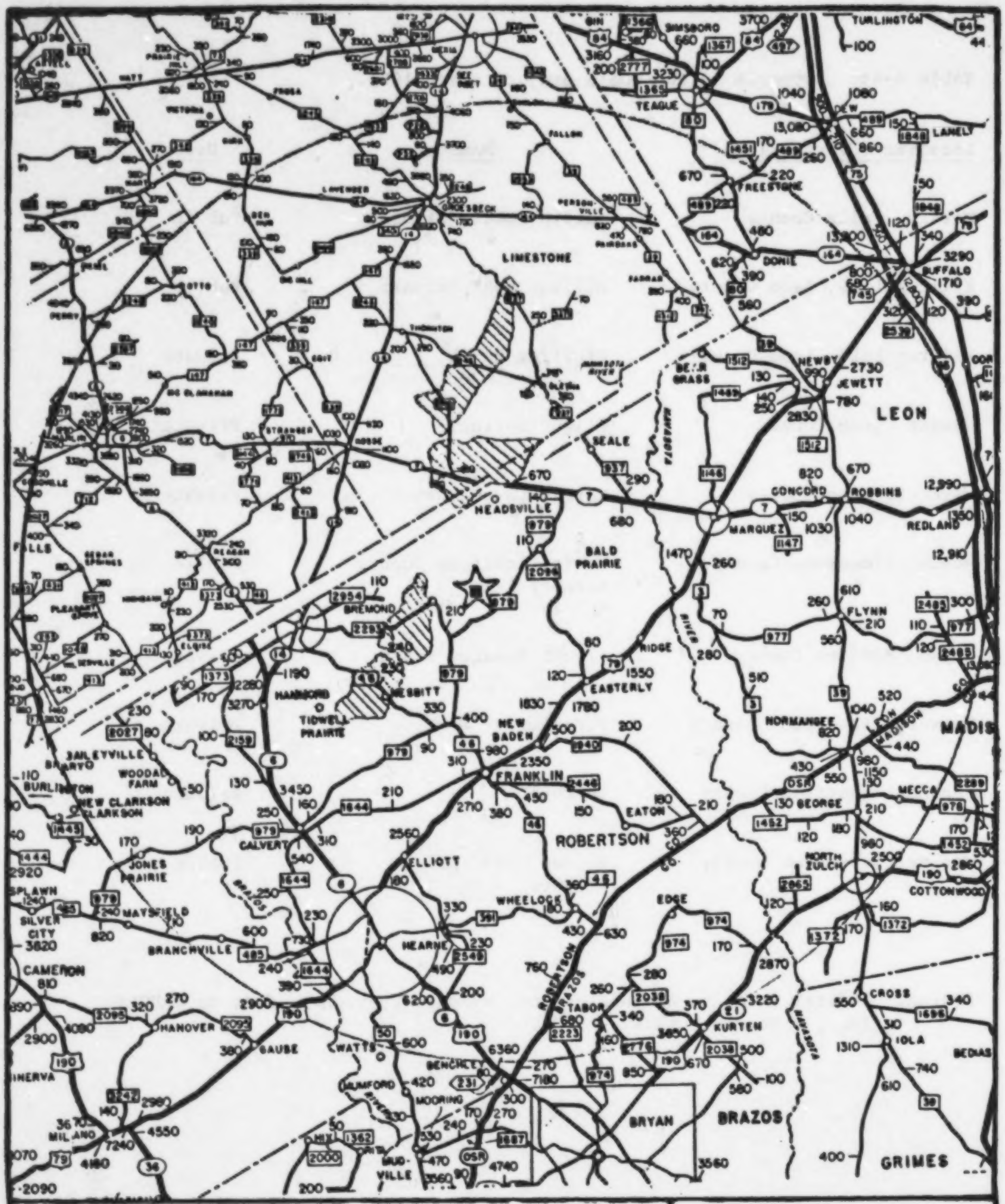
Rail lines in the project area include the Southern Pacific Railroad, Missouri Pacific Railroad, and the Fort Worth and Denver Railroad. These lines are for freight service only. There are no existing rail lines through the Twin Oak project site or the mine sites.

6.11.1.3 Airports and Air Service

The names of the public and private airports in the TOSES project area are listed in Table 6-46. There are no military air bases in the TOSES project area.

Table 6-45. Highway and railway mileage for counties included in the TOSES project area, 1980.

County	Land Area (Sq. Miles)	Interstate Highway Mileage	State Highway Mileage	Railroad Mileage	Miles/Square Mile		
					Interstate	State	Railroad
Brazos	586	0	265	89	0.00	0.45	0.15
Falls	764	2	333	32	0.00	0.44	0.00
Freestone	865	32	305	36	0.04	0.35	0.00
Leon	1,102	29	315	73	0.03	0.29	0.07
Limestone	931	0	370	35	0.00	0.40	0.04
Madison	480	19	216	14	0.04	0.45	0.03
Milam	1,028	0	329	82	0.00	0.32	0.08
Robertson	877	0	289	115	0.00	0.33	0.13


TURLINGTON
SIMSBORO
TEAGUE
LANELY
FREESTONE
DONIE
BUFFALO
LIMESTONE
GROESBECK
PERSONVILLE
THORNTON
KOSSE
OTTO
PERRY
BIG HILL
NEWBY
JEWETT
LEON
BEAR GRASS
SEALE
HEADSVILLE
MARQUEZ
CONCORD
ROBBINS
REDLAND
BALD PRAIRIE
FALLS
BREMOND
FLYNN
RIDGE
EASTERLY
HAMMOND
TIDWELL PRAIRIE
NESBITT
NEW BADEN
NORMANGEE
MADISON
FRANKLIN
GEORGE
MECCA
EATON
ROBERTSON
BAILEYVILLE
BRANDO
BURLINGTON
WOODALL FARM
NEW CLARKSON
CLARKSON
CALVERT
ELLIOTT
JONES PRAIRIE
NORTH ZULCH
COTTONWOOD
SPLAWN
SILVER CITY
MAYSFIELD
WHEELOCK
EDGE
BRANCHVILLE
HEARNE
CAMERON
TABOR
KURTEN
CROSS
IOLA
BEDIAS
HANOVER
GAUSE
WATTS
BENCHLEY
MUMFORD
MOODING
MINERVA
MILANO
BRYAN
BRAZOS
GRIMES
NAVASOTA RIVER
BRAZOS RIVER

N

▨ Twin Oak Mine Sites

☆ Twin Oak Station

1 in. = 8 mi.

Figure 6-20. Average annual 24-hour traffic volume for the TOSES project area (TDHPT 1979).

Table 6-46. Airports in the TOSES project area, 1981.

Location (Nearest Town)	Name	Use
Marlin, Falls County	Marlin Public Airport	Public
Hilltop Lake, Leon County	Hilltop Lake Airport	Public
Hilltop Lake, Leon County	Pfeiffer Ranch	Private
Jewett, Leon County	Flight Springs	Private
Marquez, Leon County	Morris Lazy K Ranch	Private
Mexia, Limestone County	Mexia-Limestone County Airport	Public
Leono, Madison County	Fly-In Brangus Ranch	Private
Calvert, Robertson County	Putz Aerial Service	Private
Hearne, Robertson County	Corpora	Private
Hearne, Robertson County	Hearne Municipal Airport	Public

Source: Federal Aviation Administration, by phone, Mr. Box, FAA, to WAPORA, Inc., 2 November 1981.

6.11.2 Environmental Consequences From the No Action Alternative

If this project is not completed, transportation in the project area will not change significantly unless another major project is developed in the area. Changes in traffic patterns and systems as a result of past construction have been fairly minor. Coordination between TUCS, Texas Department of Highways and Public Transportation (TDHPT), and county officials to upgrade the area transportation systems will offset many past and future project effects. An example of this action was the improved segment of FM 979 performed by a TUCS contractor through agreement with TDHPT.

6.11.3 Environmental Consequences From the Construction and Operation of the Proposed Project

Texas Utilities Services Inc. (TUSI) anticipates most workers involved with construction and operation of the TOSES will be hired from outside the project area and will relocate within 50 miles of the project site. The transportation projections and effects evaluations which follow are based on this assumption.

6.11.3.1 TOSES and Associated Facilities

Highways. One of the most noticeable transportation effects will be an increase in traffic volume. During the peak construction year of 1987 there will be approximately 1,000 construction workers and 234 operation workers involved with the TOSES. There will be approximately 353 workers needed for long-term operation of the TOSES (1996-2018). The probable location of these workers' homes was predicted using the same distribution factors used previously for population influx disaggregation. In determining figures for the number of vehicular trips from each town to the site per day, it was assumed that there will be 1.3 workers per vehicle who will be making two trips per day. This results in 1,898 vehicular trips per day in 1987. It was assumed that the workers would take the shortest and most direct route to the site.

An evaluation was made of the effect of these construction and operation-related vehicular trips on local roadways. This evaluation was based on the "worst-case" assumption that all employees will be required to report to work at approximately the same time. In addition, the highest 24-hour average annual traffic volume on a road segment was used to represent the entire segment. These assumptions resulted in a conservative analysis.

In addition to traffic caused by employment at the TOSES, traffic will be generated by delivery and service vehicles coming to the site. Also, there will be increased traffic between towns because of additional service workers and families who will be traveling between communities. These and other variables make an accurate forecast of secondary vehicular trips impossible. Consequently, actual traffic volumes that will occur during construction and operation of the proposed TOSES will be higher than those shown in Table 6-47.

The projected traffic volume increase in vehicles per hour for various roadway segments within 50 miles of the Twin Oak project site, as well as the percentage increase over 1979 traffic volumes, is presented in Table 6-46. Those roads which will experience a 50% increase or greater in 1987 include State Highway (SH) 7 (between Marlin and Kosse, and Kosse and FM 979); SH 6 (between SH 164 and SH 7); US 79 (between Hearne and Franklin); FM 46 and FM 979 (between Franklin and FM 2293); FM 979 (between FM 2293 and TOSES, and between TOSES and SH 7); and FM 2293 (between Bremond and FM 979). FM 979 (between FM 2293 and SH 7) has the most substantial increase (1900-2614%) over 1979 traffic volumes. During long-term operation (1996-2018), the traffic volume increase attributable to the TOSES and associated facilities will be considerably less, with only the following road segments exceeding a 50% increase: SH 7 (between Kosse and FM 979); FM 46 and FM 979 (between Franklin and FM 2293); FM 979 (between FM 2293 and TOSES, and between TOSES and SH 7); and FM 2293 (between Bremond and FM 979).

The increase in traffic will result in an inconvenience to local residents due to greater traffic volumes and an increase in the potential for traffic accidents. Increased traffic volumes also will cause the capacity of some roads in the project area to be exceeded. The capacity of a highway designates the number of vehicles per hour the road is designed to handle.

Table 6-47. Estimated traffic volumes generated by power plant workers.

						During Peak Construction Year (1987)			During Long-term Operation (1996-2018)		
Highway	From	-	To	Roadway Capacity (vph)*	Estimated 1979 Volume (vph)[a,b]	Additional Traffic (vph)	Total Traffic (vph)	% Increase	Additional Traffic (vph)	Total Traffic (vph)	% Increase
I 35	Temple	-	SH 7/FM 107	4,000	3,539	118	3,657	3	34	3,573	0
SH 7	IH 35	-	Marlin	800	489	118	607	24	34	523	7
	Marlin	-	Kosse	800	582	476	1,058	82	136	718	23
	Kosse	-	FM 979	800	165	516	681	312	149	314	90
	FM 979	-	Marquez	800	102	33	135	32	10	112	10
	Marquez	-	Centerville	550	203	15	218	7	4	207	2
SH 6	Waco	-	SH 164	2,000	1,124	326	1,450	29	93	1,217	8
	SH 164	-	SH 7	800	651	326	977	50	93	744	14
	Bryan	-	Hearne	800[c]	1,077	315	1,392	29	98	1,175	9
	Calvert	-	SH 14	800	518	12	530	2	3	521	1
US 190	Cameron	-	Hearne	1,000	1,086	21	1,107	2	6	1,092	1
US 79	Hearne	-	Franklin	1,000	407	364	771	89	104	511	26
	Buffalo	-	Marquez	1,000	468	16	484	3	5	473	1
FM 46 & FM 979	Franklin	-	FM 2293	550	147	379	526	258	108	255	73
FM 979	FM 2293	-	TOSES	550	21	399	420	1,900	121	142	576
	TOSES	-	SH 7	550	21	549	570	2,614	159	180	757
FM 2293	Bremond	-	FM 979	550	36	20	56	56	5	41	14
I 45	Fairfield	-	Buffalo	4,000	1,995	10	2,005	1	3	1,998	0
	US 75	-	SH 7	4,000	1,985	11	1,996	1	3	1,988	0
SH 14	Mexia	-	Groesbeck	800	609	25	634	4	8	617	1
	Groesbeck	-	Kosse	800	333	40	373	12	13	346	4

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[a] Estimated 30th hour traffic taken as 15% of average annual 24-hour traffic.

[b] When more than one traffic volume was available for a road segment, the highest volume was used.

[c] This capacity does not include scheduled improvements to this segment of SH 6.

* vph = vehicles/hour

During the peak construction year (1987), traffic volumes on the following road segments will approach or exceed the roadway capacity due to traffic increases associated with the TOSES: SH 7 (between Marlin and Kosse); SH 6 (between SH 164 and SH 7); FM 46 and FM 979 (between Franklin and FM 2293); and FM 979 (between TOSES and SH 7). Based on a worst-case analysis, the capacities of SH 6 (between Bryan and Hearne) and US 190 (between Cameron and Hearne) were exceeded in 1979. The relatively small percentage increase associated with the construction and operation of the TOSES will not significantly affect these road segments. The segment of SH 6 between Bryan and Hearne currently is scheduled to be expanded to a four-lane undivided highway, with the major portion being completed by 1984 and a 3-mile segment northwest of Bryan being completed by 1987 or 1988 (by phone, John Blasienz, TDHPT, District 17, 25 March 1982). When the capacities of these road segments are reached, a condition of extreme traffic congestion will exist, and an increase in traffic collisions potentially will be associated with these congested conditions. However, adequate capacity for all other roads is available if the maximum hourly roadway capacity is applied for 24 hours. Therefore, highway capacity may be a problem only when a high percentage of the work force arrives and departs from the site at the same time. If the work force is staggered so that employees arrive and depart at different times during the day, there is a reduced possibility of exceeding the road capacities.

Railroads. No rail line intersects the Twin Oak project site. A company-owned railroad spur has been constructed for transporting lignite to the plant. This line is not expected to cause an adverse effect on the rail system in the project area.

Airports and Air Service. The TOSES and associated facilities should cause no adverse effect on airports and air service in the project area.

6.11.3.2 Transport Systems

The number of employees needed for the construction and operation of the transport systems was not separated from the total employees associated with the TOSES, therefore a separate analysis is not possible. However, it is expected that the transport systems alone will have very little effect on the traffic volumes in the project area.

There will be some disruption of traffic at the locations where the company-built railroad spur intersects public higways when the unit train begins to operate. This disruption will be short-term in nature. The railroad spur will connect with an existing Southern Pacific railroad running between Groesbeck and Kosse. Construction of the spur has not caused significant delays or otherwise affected rail traffic using the Southern Pacific railroad.

6.11.3.3 Mine

Highways. During the peak construction year of 1987, there will be approximately 150 construction workers and 235 operation workers involved with the Twin Oak mine. Subsequently, there will be approximately 971 workers needed for long-term operation of the mine (1996-2018).

The same assumptions used in the previous section were used here to determine the number of vehicles per day from each town to the proposed mining sites. It is expected that there will be an additional 592 vehicular trips per day in 1987, and 1,494 vehicular trips per day from 1996 through 2018. In addition to traffic caused by employment at the Twin Oak mine, traffic will be generated by delivery and service vehicles coming to the site. Also, there will be an increase in traffic between towns because of additional service workers and families who will be traveling between communities. These and other variables prevent an accurate forecast of secondary vehicular trips. Consequently, actual traffic volumes that will occur during construction and operation of the Twin Oak mine will be higher than those presented in Table 6-48.

The projected traffic volume increase in vehicles per hour for various roadway segments within 50 miles of the first 5-year mine site, as well as the percentage increase over 1979 traffic volumes are presented in Table 6-48. Those roads which will experience a 50% increase or greater during the peak construction year (1987) and operation period (1996-2014) include SH 7 (between Kosse and FM 979); FM 46 and FM 979 (between Franklin and FM 2293); and FM 979 (between FM 2293 and TOSES, and between TOSES and SH 7).

Table 6-48. Estimated traffic volumes generated by the mine workers.

Highway	From	-	To	Roadway Capacity (vph)*	Estimated 1979 Volume (vph)[a,b]	During Peak Construction Year (1987) Additional Traffic (vph)	During Peak Construction Year (1987) Total Traffic (vph)	During Peak Construction Year (1987) % Increase	During Long-term Operation (1996-2018) Additional Traffic (vph)	During Long-term Operation (1996-2018) Total Traffic (vph)	During Long-term Operation (1996-2018) % Increase
I 35	Temple	-	SH 7/FM 107	4,000	3,539	37	3,576	1	93	3,632	3
SH 7	IH 35	-	Marlin	800	489	37	526	8	93	582	19
	Marlin	-	Kosse	800	582	149	731	26	374	956	64
	Kosse	-	FM 979	800	165	162	327	98	406	571	246
	FM 979	-	Marquez	800	102	12	114	10	26	128	25
	Marquez	-	Centerville	550	203	2	205	1	11	214	5
SH 6	Waco	-	SH 164	2,000	1,124	102	1,226	10	256	1,380	23
	SH 164	-	SH 7	800	651	102	753	16	251	907	39
	Bryan	-	Hearne	800[c]	1,077	98	1,175	9	247	1,324	23
	Calvert	-	SH 14	800	518	4	522	1	9	527	2
US 190	Cameron	-	Hearne	1,000	1,086	6	1,092	1	16	1,102	1
US 79	Hearne	-	Franklin	1,000	407	113	520	28	275	692	68
	Buffalo	-	Marquez	1,000	468	5	473	1	13	481	3
FM 46 & FM 979	Franklin	-	FM 2293	550	147	122	269	83	306	453	208
FM 979	FM 2293	-	TOSES	550	21	124	145	590	321	342	1,528
	TOSES	-	SH 7	550	21	187	208	890	432	453	2,057
FM 2293	Bremond	-	FM 979	350	36	6	42	17	15	51	42
I 45	Fairfield	-	Buffalo	4,000	1,995	3	1,998	0	8	2,003	0
	US 75	-	SH 7	4,000	1,985	3	1,988	0	8	1,993	0
SH 14	Mexia	-	Groesbeck	800	609	8	617	1	20	629	3
	Groesbeck	-	Kosse	800	333	13	346	4	32	365	9

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[a] Estimated 30th hour traffic taken as 15% of average annual 24-hour traffic.

[b] When more than one traffic volume was available for a road segment, the highest volume was used.

[c] This capacity does not include scheduled improvements to this segment of SH 6.

*vph = vehicles/hour

The increase in traffic will result in an inconvenience to local residents due to greater traffic volumes and an increase in the potential for traffic accidents. Increased traffic volumes also will cause the capacity of some roads in the project area to be exceeded. However, as discussed in the previous section, coordination between TUCS, TDHPT, and county officials to upgrade the area transportation system will offset many of the project's adverse effects. During the peak construction year (1987), traffic volumes on the following road segments will approach or exceed the roadway capacity due to traffic increases associated with the Twin Oak mine: SH 7 (between Marlin and Kosse) and SH 6 (between SH 164 and SH 7). Based on a worst-case analysis, the capacity of SH 6 (between Bryan and Hearne) and US 190 (between Cameron and Hearne) was exceeded in 1979. The relatively small percentage increases associated with the mine for SH 6 and US 190 (9% and 1%, respectively) will not significantly affect these road segments. As was discussed earlier, this segment of SH 6 currently is scheduled to be expanded to a 4-lane undivided highway. When the capacities of these road segments are reached, a condition of extreme traffic congestion will exist. An increased likelihood of traffic collisions will be associated with these congested conditions. However, like the power plant, adequate capacity for all other roads is available if the maximum hourly roadway capacity is applied for 24 hours. Therefore, highway capacity may be a problem only when a high percentage of the work force arrives and departs from the site at the same time. If the work force is staggered so that employees arrive and depart at different times during the day, there is a reduced possibility of exceeding the road capacities.

Several State Highways and Farm to Market roads intersect the mine sites (see Figure 6-20), and therefore will be relocated prior to mining. At a later date (nearer the time when the relocations are required) arrangements will be made with the Texas Department of Highways and Public Transportation for the proposed relocations (TUSI 1981b).

Railroads. No rail lines intersect the Twin Oak mine sites. A company-owned railroad spur will be constructed for transporting lignite to the plant. The Twin Oak mine should cause no effect on railroads in the project area, however, railroad revenues should increase with the increase in rail traffic associated with construction and operation of the project.

Airports and Air Service. The Twin Oak mine should cause no adverse effect on airports and air service in the project area.

6.12 PUBLIC HEALTH

6.12.1 Existing Conditions

There are four major components of the lignite fuel cycle -- extraction, transportation, combustion, and waste disposal. Each has a set of associated risks, injuries, and disease in the form of morbidity and/or mortality to the occupational and general populations. Occupational morbidities and mortalities occur as the result of respiratory diseases and job-related accidents. Adverse effects to public health can result from transportation accidents and from pollutants (fugitive dust, sulfates, iron, manganese, zinc, and other trace elements) which are discharged to air and water. Increased morbidity and/or public mortality can result in respiratory disease caused by increased air pollution, while a decrease in the quality of the water supply can influence the incidence of infectious diseases and possible non-infectious diseases.

The following subsections address the five broad components of the lignite fuel cycle. Distinctions are made between occupational and public health risks.

6.12.1.1 Extraction

Dust can present a major environmental public health problem during surface lignite mining if not controlled. Of the five components in the coal/ lignite fuel cycle, the extraction process has the greatest rate of fatal occupational injury. This is not suprising when one considers the physical hazards of daily activities in coal mining. In the future, as stricter safety regulations are enforced, the number of injuries should decrease.

6.12.1.2 Transportation

Injuries occurring during coal transportation include injury to the railroad work force, trespassers on railroad property, and injuries that occur as a result of highway accidents.

6.12.1.3 Combustion

The principal components of the emission stream have known effects on human health which include physiological irritation and direct toxicity. Some of the more important emissions are sulfur dioxide, nitrogen oxides (important compounds are nitric oxide and nitrogen dioxide), and particulates.

6.12.1.4 Waste Disposal

The two main types of solid wastes generated by the power plant are ash (bottom and fly) and scrubber sludge. Both are produced on-site in large quantities and their ultimate disposal must be considered carefully. The public health risk of the final phase of the coal fuel cycle, waste dispsoal, has two parts: risks occurring from decreased water quality, and accident risk associated with transportation of combustion wastes to a disposal site. Water quality parameters that can be affected are alkalinity, pH, solubility of metal components, dissolved solids, and suspended solids which can result from ash pond overflow or ash pile runoff. Transport of combustible wastes presents a recognizable risk of injury to the public. An occupational health effect may result from exposure to fugitive dust. When waste disposal occurs away from the site of combustion, the risk of vehicular accidents also is increased.

6.12.2 Environmental Consequences From the No Action Alternative

If the no action alternative is implemented there will be no environmental consequences on public health.

6.12.3 Environment Consequences From Construction and Operation of the Proposed Project

Construction and operation of the TOSES, transport systems, and mine will have a direct effect on local health and safety conditions, because a necessary corollary of any industrial development is the introduction of new and different safety hazards for people employed in the operation. Increased risks to the health and safety of residents and employees would be associated with many aspects of the operations of the projects, especially the lignite handling processes. Some significant amounts of lignite dust may be produced during the mining, loading, hauling, stacking, and reclaiming operations. This could have an effect on the respiratory health of the employees. However, the applicant will be required to follow any regulations relative to employee health and safety. In addition, mandatory MSHA and OSHA monitoring will be conducted.

By careful control of all aspects of the mining, transport, and use of lignite, the aforementioned adverse effects can be mitigated or reduced, but not eliminated.

6.12.3.1 TOSES and Associated Facilities

The major components of the lignite fuel cycle that are directly related to the TOSES include lignite combustion and waste disposal.

Combustion. The major pollutants emitted during lignite combustion are sulfur oxides, nitrogen oxides, particulate matter, and lesser quantities of carbon monoxide and carbon dioxide. The emission limits as specified in the State and Federal air permits, should protect the public health. Further, the emission control equipment has been designed and engineered to meet all applicable State and Federal permit requirements.

Waste Disposal. Both the ashes (fly and bottom) and scrubber sludge are not, as a general category, hazardous wastes. Disposal of these waste will conform to EPA and Texas Department of Water Resources technical guidelines for design, construction, and operation of landfill waste disposal facilities.

These guidelines were promulgated to prevent contamination of surface and groundwater, thereby reducing potential risks to the general public.

Potentially hazardous waste produced at the TOSES including waste oil, absorbent shop material, and used batteries, etc., will be retained and stored prior to their shipment to an approved disposal facility. Long-term, on-site storage of these materials will not be allowed.

6.12.3.2 Transport Systems

Coal haulage in coal mining operations currently accounts for between 10 and 15% of the total mining fatalities. A worker at the controls of a vehicle is in a more dangerous location than a worker performing support tasks. Workers in vehicles are involved in 82% of the total haulage-related accidents, and account for 69% of the total man-days lost. Estimated rail accident rates involving some form of coal transport are 0.06 fatal injuries and 0.585 non-fatal accidents for every 10^{12} Btu equivalent ton shipped. Trucking rates are estimated at 0.032 fatalities and 0.69 non-fatal injuries for 10^{12} BTU energy shipped (USEPA 1977a).

A considerable increase in local traffic can be anticipated due to the proposed project. Increase in vehicular traffic may affect local conditions, both with respect to increased traffic accidents, and air pollution. Because miles travelled correlate directly with numbers of accidents, this too would be a negative safety impact of the proposed project.

6.12.3.3 Mine

The two remaining components of the fuel cycle, extraction and handling, are generally associated with mining. Both processes may have adverse effects on health and safety of area residents and workers.

Dust may present a major environmental problem during the extraction process, particulary during periods of high winds and low rainfall. The effects of this fugitive dust are reduced somewhat by the fact that the mine is located in a sparsely populated area. Planning will be essential in designating areas of potential high dust pollution and implementing the best available technology to maintain airborne dust at acceptable levels. Haul and service roads will be watered frequently to suppress dust. To control fugitive emissions of lignite dust, wet dynamic type or combustion dry cyclone-wet dynamic type dust suppression and wind barrier systems will be located at all lignite transfer and unloading points.

Historical data indicate that coal mining is a dangerous occupation. However, the majority of occupational deaths and injuries occur in underground mining and to the transportation sectors. The threat to personal health and safety from mining accidents depends on the extraction technique used, the location of the mine, the activity of the mine, the experience of the mining crew, the equipment used, the safety precautions and procedures employed in the mine, as well as other factors. The frequency of injury and death at surface mines remains significantly less than in underground mines, even though a greater reliance has been placed on surface mining in recent years.

6.13 ENERGY RESOURCES

6.13.1 Existing Conditions

Energy consumption in the project area is associated primarily with residential and commercial use rather than heavy industry. Common forms of energy supplies include:

- Electricity - The primary supplier of electricity in the project area is the Robertson Electric Cooperative Inc. which purchases wholesale energy from the Brazos Electric Power Cooperative. Robertson Electric Cooperative does not anticipate any significant problems in meeting future demand (by phone, Wendell Hall, Robertson Electric Cooperative Inc., 11 March 1982).
- Natural Gas - A good supply of natural gas exists for the project area and is supplied by Lone Star Gas Company. The project area is located within Lone Star's extensive transmission and distribution system in Texas. Lone Star Gas does not anticpate any problems in meeting future demand (by phone, Warren Fulks, Lone Star Gas Co, 11 March 1982).
- Propane and Butane - Propane and butane are used in rural areas where natural gas service is not available. Propane has been readily available, with usage increasing concurrent with population growth. Butane is being phased out as a fuel due to increasing cost and difficulty in use.

- Petroleum Products - Diesel fuel and gasoline are available from local and regional suppliers. The allocation of fuels has been deregulated therefore the supply is allowed to fluctuate with demand. There presently is an adequate supply of diesel fuel and gasoline in the project area.

- Lignite - The TOSES project area is underlain by sizable deposits of lignite. Three separately owned lignite mines are planned for the project area. The location of two of three planned mines in the project area is shown in Figure 5-3. The third mine is planned for Robertson County; however, the exact location currently is unknown. Electric generating stations are planned to accompany at least two of the three mines.

6.13.2 Environmental Consequences From The No Action Alternative

If the TOSES project is not completed, there will be no significant additional demand on the energy resources of the project area. Without the TOSES, the energy value of the lignite will not be utilized at this time and the potential electricity would not be available for distribution.

6.13.3 Environmental Consequences From Construction and Operation of the Proposed Project

6.13.3.1 TOSES and Associated Facilities

Electricity for the construction of the TOSES and associated facilities will be supplied by Texas Power and Light Company (TP&L) via a substation from the Brazos Electric Power Cooperative. Electric power will be provided for construction on a permanent basis by TP&L at a later date. During plant operation, electricity will be supplied by TP&L or TOSES auxiliary units. Diesel fuel needed during the construction of TOSES and the associated facilities will be arranged by the contractor and probably will come from a local or regional supplier. During operation, diesel fuel will be supplied by Texas Utilities Fuel Company (TUFCO), which uses non-local sources.

It is not anticipated that the construction or operation of the TOSES and associated facilities will significantly affect the supply of electricty, natural gas, or propane available in the project area. During construction, the diesel fuel probably will be supplied by local or regional suppliers, however, this should not deplete local supplies since the allocation of diesel fuel is no longer regulated.

6.13.3.2 Transport Systems

Electricity needed for construction of the transport systems will be supplied by TP&L. Electricity for the operation of the make-up water pumps will be supplied by TP&L, while electricity to run the trains will be supplied by the TOSES. Diesel fuel needed for construction will be obtained from local/regional suppliers, and fuel needed for operation and maintenance will be supplied by TUFCO. The construction and operation of the transport system will not affect the energy resources in the project area.

6.13.3.3 Mine

The major equipment used for mining will be fueled by electricity (dragline) and diesel fuel (shovel, scrapers, etc.). The electricity will be supplied by the TOSES and the diesel fuel will be supplied by TUFCO. TUFCO does not utilize local suppliers for diesel fuel and there will be no effect on local supplies.

The lignite that will be mined is considered an energy resource of the project area. The mining and use of the lignite will be an irrevocable commitment of this resource.

6.14 EFFECTS OF ALTERNATIVES AVAILABLE TO EPA

Alternatives available to EPA in accordance with its regulatory and permitting authority pursuant to Section 402 of Federal Water Pollution Control Act (FWPCA) are to issue or to deny the new source NPDES permit requested by TUGCO for the TOSES discharge to Duck Creek. Conditional requirements or modifications based on anticipated project impacts may be added to the permit, if warranted.

6.14.1 Issuance of Permit

The issuance of the new source NPDES permit will allow TUGCO and Alcoa Company to operate the TOSES as described in Chapter 5.0 and to discharge wastewater into Duck Creek up to the limits set forth in the permit. The permit may be modified by certain conditions which require that additional monitoring and reporting be undertaken during the operation of the TOSES in order to evaluate the effectiveness of the pollution control systems. Special conditions will be added to the permit if projected environmental impacts of the operation of the power plant warrant additional monitoring and reporting.

6.14.2 Denial of Permit

EPA could deny the NPDES permit if (1) the discharges from the TOSES to Duck Creek violate effluent limitations, and/or water quality standards, (2) discharges are found to have a significant adverse impact on the human environment, or (3) if environmental considerations such as endangered species, historic and/or archaeological sites, potential prime farmland, etc. are significantly affected, and measures for mitigating adverse impacts are not proposed or are determined unacceptable. Denial of the permit would likely result in the applicat suspending construction on the project, and no effluent discharges to Duck Creek. Should the NPDES permit application be denied by EPA, TUSI would have the options of redesigning the pollution control facilities and/or other project plans and resubmitting the application, locating and evaluating another project, or pursuing the no-project alternative.

6.15 EFFECTS OF ALTERNATIVES AVAILABLE TO OTHER PERMITTING AGENCIES

Permits other than the NPDES permit for the TOSES have been obtained (see Table 3-1). The TRC will require TUGCO to apply for a surface mining permit. TUGCO plans to submit the first 5-year mine permit application to TRC in October 1983. Should TRC deny the mining permit, the proposed project schedule probably would be extended until appropriate clarifications/ modifications could be made to project plans.

6.16 IRRETRIEVABLE AND IRREVERSIBLE RESOURCE COMMITMENTS

The major resources committed through the implementation of the proposed project include: capital, energy, land, labor, water, and unsalvageable materials. There is a significant consumption of these resources with no feasible means of recovery. Thus, non-recoverable resources will be foregone in order to construct and operate the proposed TOSES, transport systems, and lignite mines.

Mining operations are expected to reach an average production level of 7.9 million tons per year of lignite over the 35-year life of the project. Lignite will be lost to any other future use since it will be burned as fuel at the TOSES. An estimated 280 million tons of lignite will be mined during the life of the project.

Construction and operation of the proposed projects will require electricity, liquid fuels in the form of fossil fuel and gasoline, lubricants, and structural and repair materials. Diesel fuel used for powering mobile equipment will be the primary petroleum fuel consumed during facility operations. The TOSES will consume limestone and various commercial chemicals used in plant operation, equipment cleaning and maintenance, and waste treatment.

Existing vegetation in areas cleared prior to construction will be lost. Some revegetation is planned along roadways and in peripheral areas. Although mining will preclude the reestablishment of some pre-mining native species, theoretically they could be reestablished with proper soil conditioning and care. Preliminary reclamation plans are designed to establish native grasslands.

An irreversible decline is expected in the populations of those plant and animal species sensitive to construction and operations, and dependent on lotic and/or forested habitats. The net decline can be minimized by implementation of reforestation efforts during reclamation operations, however, extensive reforestation is not expected.

The commitment of human resources associated with the projects (i.e., labor) is irretrievable, but is considered beneficial because new employment opportunities will be created. Specific capital funds will be lost, but replaced with funds gained through the sale of electric power. Also, a source of energy to meet long-term needs in the Texas Utilities service area will result from these expenditures.

The slight to moderate growth that will occur in the project area will result in the irretrievable conversion of agricultural lands, wildlife habitat, and open space to urban uses. Although growth will permanently reduce vegetation cover and wildlife production capabilities in the project area, long-term effects should be minimal.

Accidents that could occur during construction and operation of all projects, could cause irreversible bodily damage or death, and damage to equipment and other resources.

Potential accidental destruction of undiscovered cultural sites during mining is irreversible, and would represent a permanent loss of the cultural resource site. Such losses can be minimized by systematic surveys of areas prior to excavation activities.

6.17 UNAVOIDABLE ADVERSE IMPACTS

Because of the magnitude and nature of the proposed projects, adverse impacts will occur. Although many of the impacts can be minimized or mitigated, some cannot be avoided.

Short-term unavoidable adverse impacts of the proposed project will include interruption of surface water flow; slight lowering of groundwater levels; localized increases in erosion and sedimentation, fugitive dust, stack emissions, and increased noise levels; disruption of terrestrial and aquatic habitats; temporary and permanent removal of land from current use and production; and significant increases in traffic volumes on local highways. Construction of the TOSES and transport systems, and mining activities will alter the topography and land surface characteristics. These activities will modify the quality and quantity of runoff to area streams, and some area drainage patterns.

During site preparation and construction, some siltation of small streams will occur despite efforts to prevent erosion. A reduction in water quality will occur temporarily due to increased turbidity and suspended solids caused by sediments.

Long-term unavoidable adverse impacts of the projects will include a permanent reduction in the project area of lotic environments, riparian and forest vegetation and wildlife, densities of immobile wildlife species and species diversity, as well as some permanent changes in surface and possibly groundwater resources.

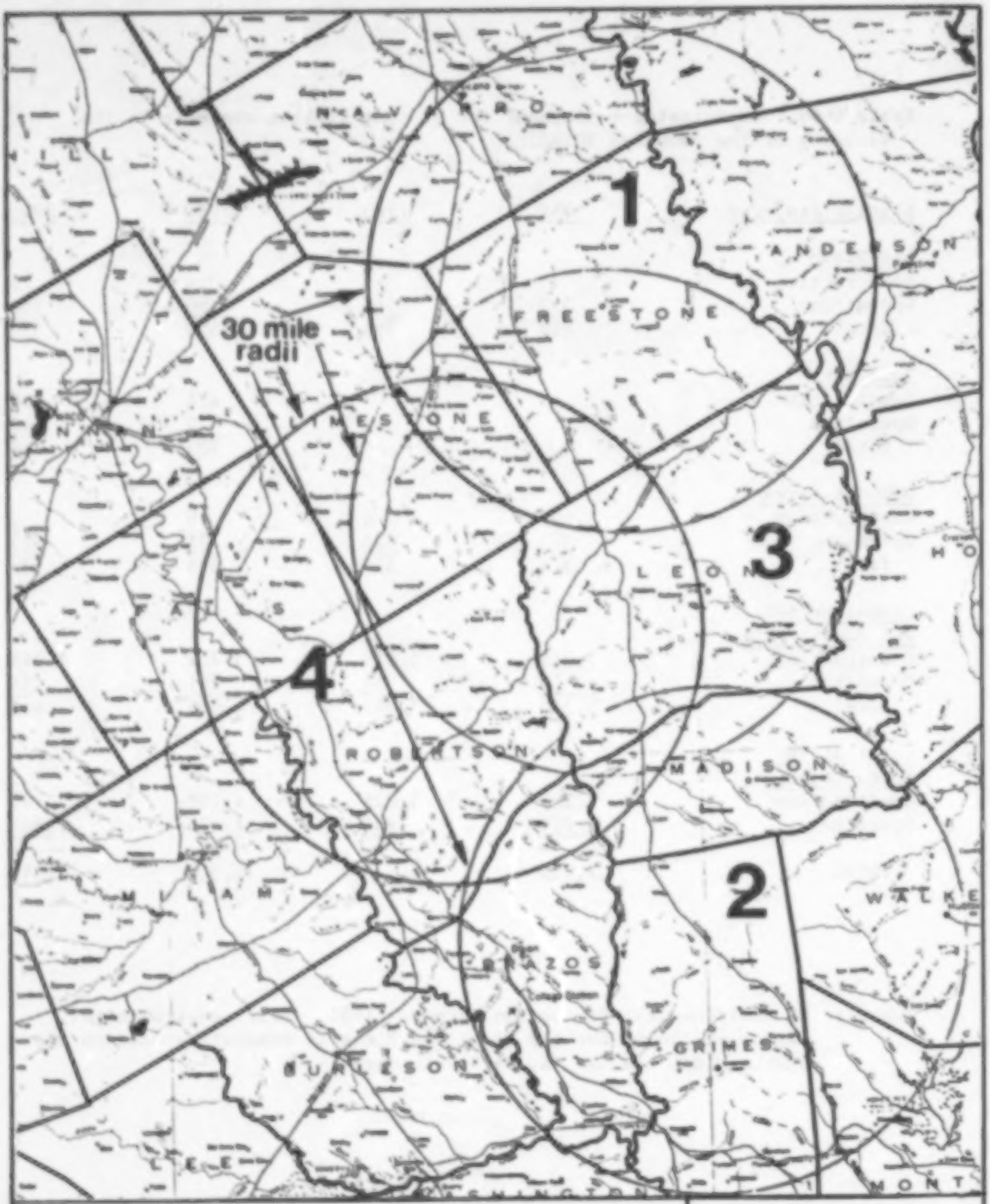
6.18 EFFECTS OF CUMULATIVE DEVELOPMENT

The primary impacts considered in this EIS so far have been those associated with construction and operation of the proposed Twin Oak project. There is a preponderance of data to suggest that the number of lignite-fueled electric generating stations and other lignite-fueled industrial operations in Texas will increase rapidly and will be the trend for at least the next 25 years. Because of this, there is a growing concern both within the scientific community and among the lay public about the cumulative long-term impacts from this proliferation of lignite extraction and associated industrial development. It is far beyond the limits of this EIS to forecast and quantify the collective impacts of these projected activities. Instead, the intent of this section is to discuss in general terms the potential and projected adverse effects of major existing or planned coal developments in the vicinity of the proposed TOSES and mines. Approximately three-fourths of the area located within 30 miles of the TOSES is also within the 30-mile radius of the Big Brown project (TUSI), Gibbons Creek project (Texas Municipal Power Agency), and Limestone project (Houston Lighting and Power). Therefore, most of the project area will be affected by more than just the Twin Oak project (see Table 6-49 and Figure 6-21). A brief qualitative synopsis of potential cumulative impacts is presented in the following pages.

Table 6-49. Anticipated employment for various lignite projects in the vicinity of the proposed TOSES.

Lignite Projects	1982	1983	1984	1985
Big Brown				
Construction	0	0	0	0
Operation	550	550	550	550
Total	550	550	550	550
Twin Oak				
Construction			425	750
Operation			0	18
Total			425	768
Gibbons Creek				
Construction	50	0	0	0
Operation	325	325	325	325
Total	375	325	325	325
Limestone EGS and Jewett Mine				
Construction	1,315	3,025	3,707	1,945
Operation	15	58	301	754
Total	1,330	3,083	4,008	2,699
Total of The Four Projects				
Construction	1,365	3,025	4,132	2,695
Operation	890	933	1,176	1,647
TOTAL	2,255	3,958	5,308	4,342

Source: US Environmental Protection Agency. 1981. Draft environmental impact statement for the Limestone Electric Generating Station and Jewett Mine. Dallas TX, variously paged.


NAVARRO
1
ANDERSON
FREESTONE
30 mile radii
LIMESTONE
3
LEON
HO
FALLS
4
ROBERTSON
MADISON
2
MILAM
WALKER
BRAZOS
GRIMES
BURLESON
LEE
WASHINGTON
MONT

N

1 in. = 16 mi.

1 Big Brown power plant and mine

2 Gibbons Creek lignite mine and power plant

3 Limestone Electric Generating Station and Jewett mine

4 Twin Oak power plant and mine

Figure 6-21. Location of major lignite energy projects in the region.

- Air Quality. Currently, the project area is in attainment of National Ambient Air Quality Standards (NAAQS). Federal Prevention of Significant Deterioration (PSD) regulations are designed to limit the deterioration of air quality in attainment areas from emissions of SO_2 and particulates. Both the NAAQS and PSD Class II increments should be met by proposed projects in the region. Acid precipitation potentially may occur, although atmospheric chemistry technology currently does not allow precise prediction of change in the pH of rainfall, or the location precipitation will occur. The potential for damage to aquatic and terrestrial organisms sensitive to acid precipitation is documentable but not quantifiable.

  Air pollutants from lignite mining include fugitive dust from surface mines and coal piles, and equipment exhausts. Air pollutants from lignite and coal combustion include particulates, sulfur dioxide (SO_2), and nitrogen (NO_x), as well as small amounts of carbon monoxide, hydrocarbons, and trace metals. Controls are available to substantially reduce emissions of all pollutants from combustion.

- Solid Waste Disposal. A by-product from coal and lignite combustion is large quantities of solid wastes -- primarily scrubber sludges and ashes. In principle, the transformation of air pollution to solid waste results in a more easily managed disposal problem. However, the potential for adverse health impacts from scrubber sludge and ash disposal is a source of significant concern. The principal concern over improper disposal surrounds groundwater quality. This concern is based on:

  (1) Evidence that groundwater contamination from improper disposal has occurred in the past.

  (2) Groundwater often is used without treatment for drinking water.

  (3) Contaminants from solid waste usually persist in groundwater indefinitely.

  A major concern regarding solid waste disposal in the project area is the coincidence of the lignite belt with the Carrizo-Wilcox aquifer. Careful site selection and waste disposal techniques are needed to avoid threats of contamination since both groundwater use and waste disposal can be expected to increase.

- Water Resources. Water consumption for lignite development by the year 2000 will result in reductions in stream flow near major diversions. Cumulatively, these reductions can affect groundwater recharge, stream ecology, coastal freshwater inflows to bays and estuaries, and the capacity of streams to assimilate pollutants. Although flow reductions may be relatively small, they can be critical during low-flow conditions, therefore the variety in site-specific conditions may result in significant local impacts. Conflicts also may develop over water use rights and water quality.

  The quality of surface waters will be affected by effluent sources associated with power plant operations and lignite mining. Power plant cooling, boiler blowdown, ash and scrubber sludge handling, and other power plant operations will increase dissolved solids levels in return flows to receiving water bodies. These effluents also may contain toxic substances, and therefore discharges should be monitored carefully. Site runoff from active mining areas also has the potential to affect significantly the quality of surface streams through the addition of TSS, acid leachates, and toxics. A proposed concentration of mining activity in a particular watershed or sub-watershed drainage area should be evaluated closely using representative watershed models to assist in cumulative impact assessment. Pre-mining and post-mining water quality monitoring also should be conducted to establish a baseline and to alert officials to potential water quality degradation.

Surface mining may result in a long-term reduction in groundwater recharge owing to the disruption of aquifer recharge areas. The permeability of a mined area also may affect the degree to which groundwater quality problems develop (particularly from leaching of overburden materials and solid waste disposal).

- Fish and Wildlife Resources. Potential impacts on fish and wildlife from lignite development primarily result from direct destruction of habitat caused by surface mining, construction of power plants, transport systems, haul roads, impoundments for cooling reservoirs, and induced population growth. Surface mining in Texas alone is expected to result in the cumulative disturbance of approximately 374,000 acres by the year 2000. About one-half of this acreage is anticipated to occur in the northeast regions of Texas.

  Whereas mined land ususally will be reclaimed and revegetated within three years of mining, the amount of disturbed surface at any one time generally will be small relative to the cumulative total. Currently, the total acreage which may be mined is less than 1% of the total habitat available. The real impact of lignite development, however, must be measured against the quality of the habitat affected.

- Socioeconomic Resources. According to the results of a recent study (Texas Energy Advisory Council 1979), the spatial, temporal, regulatory, and social characteristics of lignite development throughout Texas may reduce the likelihood of some of the more serious socioeconomic problems summarized below:

  (1) Spatial - The lignite belt is bounded on either side by the State's two largest urban concentrations -- the Gulf Coast, and the Dallas-Austin-San Antonio corridor. Within the lignite belt are numerous, rather evenly distributed small cities and towns. This pattern of development indicates that no single community will bear all the impacts.

  (2) Temporal - The lignite development scenario forecasts sustained growth and increased development throughout the 1980's and 1990's rather than a large and sudden exploitation of the resource followed by a "burst" as the resource is depleted.

(3) Regulatory - Environmental regulations, particularly the PSD regulations for air quality, will tend to discourage additional coal development in the project area. This will tend to spread the benefits as well as impacts associated with lignite resource development.

(4) Social - The lignite belt is a region of earlier oil and gas development which has had slow economic growth and population out-migration in recent decades. As a result, many view lignite development as an economic stimulus which simply is an extension of the earlier oil and gas development.

Regardless of whether or not impacts of new lignite mines and power plants are shared among several towns or concentrated in a few communities, the demand for new services and facilities will occur in the areas of housing, public safety and fire protection, water supply and wastewater treatment, health care, and education. A resulting common dilemma will be providing early financing before increased tax revenues are available. The problem of financing can be compounded when a new facility is sited in one taxing jurisdiction and the impacts are borne by another jurisdiction. This is an equity consideration which should be addressed on a regional level.

It should be noted that energy industry forecasts reveal that cumulative investments in surface mining and power plant activities in Texas will greatly stimulate economic growth, provide new jobs, and increase tax revenues. Between 1975 and 1985, the capital investment in lignite alone is expected to exceed $750 million.

This brief discussion has summarized the principal types of concerns that may become significant issues when lignite development activities in the project area are viewed collectively. Decisions made on the proposed Twin Oak project are but a few in a series of important energy development decisions in the proposed project region.

CHAPTER 7.0
COORDINATION

7.0 COORDINATION

7.1 RESPONSIVENESS SUMMARY FOR THE SCOPING MEETING

The US Environmental Protection Agency (EPA) held a scoping meeting on 18 August 1981 in Franklin, Texas, for the purpose of receiving public input on the environmental issues that EPA should address in the Environmental Impact Statement (EIS) being prepared on the Twin Oak Steam Electric Station, Robertson County, Texas. Approximately 60 persons attended and major comments received focused on the following issues:

(1) The impact of lignite mining on the quality, quantity, uses, and recharge of groundwater.

(2) The impact of power plant and mine discharges on surface water quality, quantity and uses.

(3) The need for monitoring rates of groundwater pumping and water discharges (to the receiving stream).

(4) The need for appropriate reclamation of mined lands including segregation of acid forming materials.

EPA considered the issues raised at the meeting to be significant and addressed these concerns to the maximum extent practicable in the EIS. As the majority of concerns dealt with mining impacts, it should be understood that the mine has been determined an existing source by EPA and is therefore not subject to environmental review under the National Environmental Policy Act. As a matter of information, EPA has issued a NPDES permit for wastewater discharge from the mine effective on 10 May 1982.

As was discussed in the meeting, EPA addressed the mine as a secondary impact of the power plant, since specific details on mining were not available. We suggest that lignite mining concerns be brought to the attention of the Railroad Commission of Texas, the agency responsible for issuance of the mining permit.

Shortly after EPA's scoping meeting, additional comments were received regarding effects of selenium discharges on fish populations in the receiving water; measures for reducing soil erosion, stream sedimentation and turbidity during power plant construction and mining operations; proposed measures to detect and prevent or reduce potential leaching of metals and other pollutants from unburned lignite, fly ash and scrubber sludge; health effects from dust, noise, wastewater treatment facilities and radioactive emissions from lignite combustion; impacts on forest resources; and impacts on air quality.

EPA also considered these concerns significant and addressed them to the maximum extent possible in the EIS.

7.2 COOPERATING AGENCIES

EPA Region 6 sent 13 letters to various Federal and State agencies requesting their participation in the preparation of the Environmental Impact Statement for the Twin Oak Steam Electric Station. EPA received one affirmative reply from the Texas Railroad Commission.

7.3 SIGNIFICANT CORRESPONDENCE

Copies of significant correspondence (e.g., letters, memoranda, etc.) concerning the development and preparation of the Environmental Impact Statement for the Twin Oak Steam Electric Station are presented in Appendix 1 of this document.

7.4 MAILING LIST FOR DRAFT EIS

Listed below are governmental offices and public interest groups which will receive a copy of the Draft EIS; in addition, numerous other individuals will receive a copy of the EIS.

Federal

Soil Conservation Service
US Department of Interior
US Department of Commerce
US Department of Transportation

Federal (continued)

US Department of Agriculture
US Department of Energy
Advisory Council on Historic Preservation
National Park Service
US Geological Survey
Office of Surface Mining
Agricultural and Stabilization Service
US Department of Housing and Urban Development
US Public Health Service
US Department of Health and Human Services
Economic Development Administration
US Army Corps of Engineers
US Fish and Wildlife Service
Federal Emergency Management Agency
Rural Electrification Administration
Senator Lloyd Bentsen
Senator John Tower
Representative W.P. Gramon

State

Office of Planning and Budget
General Land Office
Texas Department of Health
State Department of Highways and Public Transportation
Railroad Commission of Texas
Texas Historical Commission
Texas Department of Water Resources
Texas Parks and Wildlife Department
Texas Forest Service
Texas Air Control Board
Governor Bill Clements

Local

Brazos Valley Development Council
Brazos-Robertson Soil and Water Conservation District

Public Interest Groups

Sportsmen's Clubs of Texas
Natural Resources Defense Council
American Wilderness Alliance
Audubon Society
Sierra Club
Texas Commission on Natural Resources
League of Women Voters

CHAPTER 8.0

LIST OF PREPARERS

8.0 LIST OF PREPARERS

Some of the tables and figures utilized in this EIS were obtained from the Environmental Information Document prepared by Texas Utilities Services, Inc. Appreciation is expressed to the applicant for making these illustrations available.

This environmental impact statement was prepared by WAPORA, Inc. for the US Environmental Protection Agency, Region 6, under the guidance of USEPA Project Officer, Mr. Clinton Spotts; Project Monitor, Mr. Norman Thomas; and staff member, Ms. Darlene Owsley. Key personnel from WAPORA include:

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CHAPTER 9.0

BIBLIOGRAPHY

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American Public Health Association. 1971. Standard methods for the examination of water and wastewater. 13th Edition. American Public Health Association/American Wastewater Association/Water Pollution Control Federation, Washington DC, variously paged.

Bailey, R.G. 1980. Description of the ecoregions of the United States. US Department of Agriculture, Ogden UT, No. 1391, 77 p. plus map.

Baldwin, John L. 1973. Climates of the US. US Department of Commerce, Washington DC, 113 p.

Blair, W.F. 1950. The biotic provinces of Texas. Texas Journal of Science 2:93-117.

Bond, Clell L. 1977. An archeological assessment of the Gibbons Creek Steam Electric Station. Texas A&M University Anthropology Laboratory Research Report No. 36, variously paged.

Bonneville Power Administration. 1977. Electrical and biological effects of transmission lines: a review. US Department of the Interior, Portland OR, 64 p.

Boreman, J. 1977. Impacts of power plant intake velocities on fish. US Fish and Wildlife Service, Office of Biological Services, Washington DC, FWS/OBS-76/20.1, 10 p.

Brazos Valley Development Council. 1979. Overall economic development program. Bryan TX, 233 p.

________. 1980. Robertson County energy impact assistance plan. Bryan TX, 129 p.

Brown, K., and R. Frye. 1981. An eye on East Texas. Texas Parks and Wildlife 39:28-30.

Bryson, H.L. 1973. Early survival and total height and foliar analyses of 11 tree species grown on strip mine spoils in Freestone County, Texas. Stephen F. Austin State University, Nacogdoches TX, variously paged.

Budiansky, Stephen. 1981. Visibility clarified. Environmental Science and Technology 15(2):135-137.

Bureau of Economic Geology. 1929. Well record circular, Robertson County. Austin TX, Well Record Circular 34, 2 p.

________. 1970. Geologic quadrangle map, Waco sheet. Austin TX, 1 sheet (1:250,000).

________. 1976. Energy resources of Texas. Austin TX, 1 sheet (1:1,000,000).

________. 1979. Mineral resources of Texas map. Austin TX, 1 sheet (1:1,000,000).

Bureau of Mines. 1981. Control of water pollution from surface mining operations. US Department of the Interior, Washington DC, 172 p.

Burt, W.H., and R.P. Grossenheider. 1976. A field guide to the mammals. Houghton Mifflin Co., Boston MA, 289 p.

Caddel, Julie M. 1981. Robertson County and the impact of the Twin Oak plant. Brazos Valley Development Council, Bryan TX, 35 p.

Carter, Ralph P., et al. 1977. Reclamation. Prepared for the Committee on Health and Ecological Effects of Increased Coal Utilization, Washington DC, 63 p.

Cloud, T. 1981. Phone, Tom Cloud, US Fish and Wildlife Service, to Roy E. Greer, WAPORA, Inc., December 1981.

Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America. Houghton Mifflin Co., Boston MA 429 p.

Cook, R.L., and W.F. Harwell. 1978. Big game investigations: whitetailed deer population trends. Texas Parks and Wildlife Department, Austin TX, Job No. 1, Federal Aid Project No. W-109-R-2.

Cooper, Hal B.H. 1978. Releases of radioactive isotopes from coal and lignite combustion. University of Texas Austin Center of Energy Studies, Austin TX, Paper No. 78-34.1, 36 p.

Coquard, A., and C. Gary. 1972. Audible noise produced by electrical power transmission lines at very high voltage. CIGRE Paper 36-03.

Dahlman, Dick A., and Kerry R. Sandstrom. 1981. Influence of transmission facilities associated with the proposed Limestone Electric Generating Station to be operated by Houston, Lighting, and Power Company. Southwest Research Institute, San Antonio TX, variously paged.

Darnell, R., W.E. Pequegnat, B.M. James, F.J. Benson, and R.A. Defenbaught. 1976. Impacts of construction activities in wetlands of the United States. US Environmental Protection Agency, Washington DC. EPA-600/3-76-045, variously paged.

Davis, Edward C., and William J. Boegly, Jr. 1981. A review of water quality issues associated with coal storage. Journal of Environmental Quality 10(2): 127-132.

Deno, E.W. 1974. Calculating electrostatic effects of overhead transmission lines. Paper No. T-40-086-5. IEEE Power Winter Meeting, New York NY, (January).

Dibble, D.S. 1981. A summary of cultural resource assessments in the Twin Oak Steam Electric Station project area, Robertson County, Texas. Report submitted to Texas Utilities Services, Inc. Texas Archeological Survey, Austin TX, variously paged.

Espey, Huston & Associates, Inc. 1980a. An assessment of the cultural resources of the Jewett Mine project area. Austin TX, Document No. 8011, variously paged.

_________. 1980b. A cultural resources inventory and assessment of the Limestone electric generating station, Limestone County and Freestone County, Texas. Austin TX, Document No. 8023, variously paged.

_________. 1980c. Baseline ecological survey of the Jewett Mine site. Austin TX, Document No. 79168, variously paged.

Flair, W.F. 1950. The biotic provinces of Texas. Texas Journal of Science 2:93-117.

Fletcher, Charles S. 1979. Gibbons Creek Lignite Project: survey and appraisal of cultural resources in the first five year mining area. Texas A&M University Cultural Resources Laboratory Research Report No. 3, variously paged.

Gavande, Sam. 1977. Developing relamation plan for proposed surface mined lands of Texas. Radian Corporation, Austin TX, variously paged.

GCA, Corp. 1981. Acid rain information book, final report. US Department of Energy, Washington DC, DOE/EP-0018, variously paged.

Gehm, H.W., and Jacob I. Bregman. 1976. Handbook of water resources and pollution control. Van Nostrand Reinhold Company, New York NY, 840 p.

Gould, F.W. 1975. Texas plants -- A checklist and ecological summary. Texas Agricultural Experimental Station, College Station Tx, MP-585/ revised, variously paged.

Hawkins, M.E., and T.J. Evans. 1976. The mineral industry of Texas in 1976. Bureau of Economic Geology, Austin TX, MRC 66, 34 p.

Harrison, Adlene. 1977. Letter, from Adlene Harrison, to H.B. Coffman, Texas Utilities Services, Inc., 22 September 1977, 2 p.

Henry, C.D. 1976. Land resources inventory of lignite stripmining areas, East Texas - an application of environmental geology. University of Texas at Austin, Bureau of Economic Geology, Geological Circular 76-2, 28 p.

Henry, C.D., et al. 1976. Reclamation at Big Brown steam electric station near Fairfield, Texas: geologic and hydrologic setting. Bureau of Economic Geology, Austin TX, variously paged.

Henry, C.D., and J.M. Bascians. 1979. Environmental geology of the Wilcox group lignite belt, east Texas. Report of Investigation No. 98. Bureau of Economic Geology, Austin TX, variously paged.

Henry, C.D., J.M. Bascians, and T.W. Duex. 1980. Hydrology and water quality at the Eocene Wilcox group: significance for lignite development in east Texas. Bureau of Economic Geology, Austin TX, Geological Circular 80-3, 9 p.

Hill, R. and B. Grim. 1975. In K.L. Dickson, and E.E. Herricks. Recovery and restoration of damaged eco-systems. Proceedings at International Symposium on Recovery of Damaged Ecosystems, Charlottesville VA, 531 p.

Holzworth, George C. 1972. Mixing heights, wind speeds, and potential for urban air pollution throughout the contiguous US. US Environmental Protection Agency, Research Triangle Park NC, 117 p.

Hons, F.M., et al. 1978. Physical and chemical properties of lignite, spoil material as it influences successful revegetation. Texas Agricultural Experiment Station, Texas A&M University, College Station TX, 9 p.

Hook, R.I. 1977. Potential health and environmental effects of trace elements and radionuclide from increased coal utilization. Prepared for the Committee on Health and Ecological Effects of Increased Coal Utilization. Washington DC, 54 p.

Hosler, Charles R. 1961. Low-level inversion frequency in the contiguous US. Monthly Weather Review 89:319-339.

Hossner, L.R. 1980. Reclamation of surface-mined lignite spoil in Texas. Texas Agricultural Experiment Station and Center for Energy and Mineral Resources, College Station TX, variously paged.

IEEE. 1972. Electrostatic effects of overhead transmission lines. Part I: hazards and effects. IEEE transactions: power apparatus and systems. Vol. PAS-91, No. 2, pp. 422-426.

__________. 1973. Electromagnetic effects of overhead transmission lines. Practical problems, safeguards, and methods of calculation. Paper No. T73, pp. 441-443.

Industrial Environmental Research Laboratory. 1980. Evaluation of fugitive dust emissions from mining. Cincinnati OH, EPA 600/9-76-001, 141 p.

Interagency Task Force on Acid Precipitation. 1981. National acid precipitation assessment plan (draft). Washington DC, 129 p.

Ippolito, John E. 1979. The Gibbons Creek Steam Electric Station Project: an archeological test and survey supplement. Texas A&M University Anthropology Laboratory Research Report No. 47, variously paged.

Jevette, G.W. 1972. Evaluation of television interference from high-voltage transmission lines. In IEEE transactions: power apparatus and systems. Vol. PAS-91, No. 2, (May/June), pp. 865-873.

Jimmy V. Morris Railroad Map Company. 1973. Texas railroad map. Dallas TX, 1 sheet.

Johnson, Daniel L. 1979. Highlights of the guideline for environmental impact statements with respect to noise. Aerospace Medical Research Laboratory, Patterson Air Force Base OH, 36 p.

Kaiser, W.R., W.B. Ayers, Jr., and L.W. LaBrie. 1980. Lignite resources in Texas. Bureau of Economic Geology, Austin TX, 52 p.

Kaiser, W.R., J.E. Johnston, and W.N. Bach. 1978. Sand body geometry and the occurrence of lignite in the Eocene of Texas. Bureau of Economic Geology, Austin TX, 19 p.

Korshover, Julius. 1967. Climatology of stagnating anticyclones east of the Rocky Mountains, 1936-1965. US Department of Health, Education, and Welfare/Public Health Service, Cincinnati OH, 15 p.

Li, T., and H.E. Landsberg. 1975. Rainwater pH close to a major power plant. Atmospheric Environment 9:81-88.

Lindorff, David E., Keros Cartwright, and Beverly L. Herzog. 1981. Hydrogeology of spoil at three abandoned surface mines in Illinois: preliminary results. Illinois Institute of Natural Resources, State Geological Survey Division, Environmental Geology Notes 98, 18 p.

McDaniel, Julie A., and Burke, Stephen. 1980. Robertson County energy impact assistance plan. Brazos Valley Development Council, Bryan TX, 129 p.

Mallouf, Michael G. 1979. Archeological investigations at Lake Limestone. Texas Archeological Survey Research Report, No. 21, variously paged.

Moore, R., and T.M. Hattman. 1977. An environmental guide to western surface mining part II: impacts, mitigations and monitoring. Prepared for the US Fish and Wildlife Service. Washington DC, FWS/OBS-78/04, variously paged.

Mountain West Research, Inc. 1976. Construction worker profile, summary report. A study for the Old West Regional Commission, Denver CO, 107 p.

__________. 1977. Economic/demographic assessment manual, current practices, procedural recommendations, and a test case. Prepared for Bureau of Reclamation, US Department of the Interior, Tempe AZ. Denver CO, 275 p.

National Electric Reliability Council. 1979. Summary of projected peak load, generating capability, and fossil fuel requirements for the regional reliability councils of NERC. Princeton NJ, 46 p.

National Forest Service/National Soil Services, Inc. 1978. Texas Utilities Services, Inc., Twin Oak electric station, impact of mining operations - groundwater quality, College Station water well study, Dallas TX, 5 p. plus maps.

Nightengale, B.A. 1981. An archeological survey of ancillary construction areas, Twin Oak Steam Electric Generating Station, Robertson County, Texas. Texas Archeological Survey, Technical Bulletin No. 53, variously paged.

Oberholser, H.C. 1974. The bird life of Texas. Volumes 1 and 2. University of Texas Press, Austin TX, 1069 p.

Oglesby, Clarkson H., and Laurence I. Hewes. 1966. Highway engineering. John Wiley & Sons, Inc., New York NY, 783 p.

ORI, Inc. 1981. The potential for coal use and related economic and air quality implications of future energy scenarios. Prepared for the National Commission on Air Quality. Washington DC, variously paged.

Peterson, R.T. 1963. A field guide to the birds of Texas. Houghton Mifflin Company, Boston MA, 304 p.

President's Commission on Coal. 1980a. The American coal miner, a report on community and living conditions in the coal fields. Washington DC, 233 p.

__________. 1980b. Coal data book. Washington DC, 235 p.

Prevost, John, and John P. Hageman. 1981. Potential magnitude of radioactive emissions associated with the proposed Limestone EGS and Jewett Mine. Working paper, Southwest Research Institute, San Antonio TX, variously paged.

Prewitt, Elton R. 1974. Upper Navasota Reservoir: an archeological assessment. Texas Archeological Survey, Austin TX, Research Report No. 47, variously paged.

__________. 1975. Upper Navasota Reservoir: Archeological Texas excavations at the Barkley and Louie Sadler sites. Texas Archeological Survey, Austin TX, Research Report No. 53, variously paged.

Prewitt, Elton R., and Kerry A. Gromebacher. 1974. An archeological and historical assessment of the areas to be affected by the proposed Twin Oak and Oak Knoll projects, east-central Texas. Texas Archeological Survey Research Report No. 43, Austin TX, variously paged.

Prewitt, Elton R. and Michael G. Mallouf. 1976. Upper Navasota Reservoir: test excavations at Lake Limestone, Spring 1976. Texas Archeological Survey, Research Report No. 66, Austin TX, variously paged.

Rare Plant Study Center. 1974. Rare and endangered plants native to Texas. University of Texas Rare Plant Study Center, Austin TX, variously paged.

Ricks, G.R., and R.H.J. Williams. 1974. Effects of atmospheric pollution on deciduous woodland. Part 2, Effects of particulate matter upon stomatal diffusion resistance in leaves of Quercus petraea (Mattuschka) Leibl. Environmental Pollution 6:87-109.

Rusek, S.J., S.R. Archer, R.A. Wachter, and T.R. Blackwood. 1978. Source assessment: open mining of coal, state of the art. Industrial Environmental Research Laboratory, Office of Research and Development, US Environmental Protection Agency, Cincinnati OH, 74 p.

Sales and Marketing Management. 1980. Survey of buying power. Part 1, 28 July 1980. New York NY, variously paged.

Senate Committee on Energy & Natural Resources. 1980. Effects of acid rain: hearings, May & June 1980. Volumes 1 and 2. US Government Printing Office, Washington DC, Publication No. 96-126.

Senate Select Committee on Small Business, and Senate Committee on Environment & Public Works. 1980. Economic impact of acid rain: hearing, September 23, 1980. US Government Printing Office, Washington DC, 224 p.

Soil Conservation Service. 1978a. General soil map, Limestone County, Texas US Department of Agriculture, Washington DC, 1 sheet.

__________. 1978b. Soil survey of Falls County, Texas. US Department of Agriculture, Washington DC, 128 p. plus maps.

__________. 1979. General soil map, Robertson County, Texas. US Department of Agriculture, Washington DC, 1 sheet.

Sorrow, W.M., and W.N. Cox. 1972. A reconnaissance of the archeological and historical resources of the Navasota River Basin, Texas. Texas Archeological Survey, Austin TX, Research Report No. 26, variously paged.

Southwest Research Institute. 1975. Environmental impact assessment report, Twin Oak and Oak Knoll steam electric power generating facilities final report. Prepared for Texas Utilities Services, Inc. San Antonio TX, variously paged.

__________. 1980. Environmental validation study for the Twin Oak steam electric station. Prepared for Texas Utilities Services, Inc. San Antonio TX, 247 p.

Suhm, D.A. 1960. A review of central Texas archeology. Bulletin of the Texas Archeological Society 29:63-107.

Swanson, V.E. et al. 1976. Collection, chemical analysis, and evaluation of coal samples in 1975. US Department of the Interior, Geological Survey, Washington DC, Open File Report 76-468, variously paged.

Tang, I.N., et al. 1981. The relative importance of atmospheric sulfates and nitrates in visibility reduction. Brookhaven National Laboratory, Upton NY, BNL 28346-R, 29 p.

Texas Air Control Board. 1980. Measurement of precipitation pH in Texas by the TACB. Austin TX, 16 p.

__________. 1981. Acid rain in Texas. Austin TX, 6 p.

Texas Department of Community Affairs. 1978. Housing model analysis. Austin TX, variously paged.

Texas Department of Community Affairs, County and Rural Services Division. 1978. Freestone County economic and population trend study. Fairfield TX, 86 p.

Texas Department of Community Affairs, County and Rural Services Division, and Heart of Texas Council of Governments. 1978. Freestone County economic and population growth trends. Austin TX, 86 p.

Texas Department of Health. 1977. Texas medical facilities inventory and utilization. Medical Facilities Planning Division, Bureau of State Health Planning and Resource Development, Austin TX, variously paged.

__________. 1978. Texas medical facilities inventory and utilization calendar year 1977. Austin TX, 503 p.

__________. 1980. Management information system permit application file as of 18 December 1980. Division of Solid Waste Management, Austin TX, 106 p.

Texas Department of Highways and Public Transportation. No date. Texas, a world of difference, official highway travel map. Austin TX, 1 sheet.

__________. 1979. District highway traffic map, District 9 and District 17. Austin TX, 2 maps.

__________. 1980. Miles and average daily vehicle miles of roads in cities in each highway system by highway districts and counties. FORM TT - City and Rural. Austin TX, variously paged.

Texas Department of Water Resources. 1976. Texas water quality standards. Austin TX, variously paged.

__________. 1977. Continuing water resources planning and development for Texas. Austin TX, variously paged.

__________. 1978a. Land use/land cover maps of Texas. Austin TX, 47 p.

__________. 1978b. Texas water quality inventory. Austin TX, variously paged.

__________. 1980a. Population projections for Texas - state/county planning regions, and 208 water quality designated areas. Economics, Water Requirements and Uses Section of the Planning and Development Division, Austin TX, variously paged.

__________. 1980b. The State of Texas water quality inventory. Austin TX, 540 p.

__________. 1981a. Groundwater quality samples for Limestone County and Robertson County. Texas Water Oriented Data Book. Austin TX, computer print-out, 31 p.

__________. 1981b. Monthly effluent data. Austin TX, 60 p.

__________. 1981c. Survey of ground and surface water use, use data file. Austin TX, computer printout (1 sheet per community).

__________. 1981d. Water level measurements for Limestone and Robertson Counties. Water well measurement system. Austin TX, computer printout, 30 p.

Texas Department of Water Resources, Planning and Development Division, Economics Section. No date. Fresh water uses in Texas. Austin TX, computer printout (1 page per county).

Texas Education Agency. 1979. 1979-80 superintendents annual report. Austin TX, 38 p.

Texas Employment Commission. 1981. Labor force estimates for Texas counties - annual average 1976-1980. Austin TX, variously paged.

Texas Railroad Commission. 1981. Coal mining regulations. Austin TX, variously paged.

Texas Utilities Services, Inc. 1980. Environmental information document and appendix for Twin Oak steam electrical station, Robertson County, Texas. Prepared for US Environmental Protection Agency. Dallas TX, variously paged.

__________. 1981a. Preliminary mining plan, Twin Oak lignite surface mine, Robertson and Limestone Counties, Texas. Prepared for US Environmental Protection Agency. Dallas TX, variously paged.

__________. 1981b. Response to EPA's comments on TOSES. Handout at meeting with EPA and WAPORA, Inc. EPA Region 6 Offices, Dallas TX, variously paged.

__________. 1982. Letter, from Texas Utilities Services, Inc., to US Environmental Protection Agency, Dallas TX, 18 March 1982, 3 p.

Texas Water Development Board. 1966. A summary of the preliminary plan for proposed water resources development in the Brazos River Basin. Austin TX, 87 p. plus plates.

__________. 1977. Continuing water resources planning and development for Texas. Austin TX, variously paged.

Transportation Research Board. 1974. Report number 117. National Cooperative Highway Research program. Washington DC, variously paged.

Turpin, Solveig A., and Margaret J. Kluge. 1980. Cultural resource sampling, survey and assessment in areas to be affected by the Twin Oak steam electric generating station, Robertson County, Texas. Texas Archeological Survey, Austin TX, Research Report No. 72, variously paged.

US Department of Agriculture. 1979. Statewide erosion study, summary of acreage measurements for the State of Texas. Soil Conservation Service, Temple TX, variously paged.

US Department of Commerce. 1965. Climatic summary of the US - supplement for 1951 through 1960 - Texas. Weather Bureau, Washington DC, 198 p.

_________. 1977. County and city data book. Bureau of the Census, Washington DC, 956 p.

_________. 1981. 1980 census of population and housing - Texas - final population and housing unit counts. Bureau of Census, Washington DC, 48 p.

US Department of Commerce/National Oceanic and Atmospheric Administration. 1980. Local climatological data annual summary with comparative data, Waco, TX. Asheville NC, 4p.

US Department of Energy, and Environmental Protection Agency. 1978. Energy/environment fact book. Washington DC, 76 p.

US Department of Energy, Department of Health and Human Services, and Environmental Protection Agency. 1980. Health effects of coal technologies: research needs. McLeon VA, 202 p.

US Department of Housing and Urban Development. 1977. Flood hazard boundary map of Robertson County, Texas. 1 map.

US Department of the Interior. 1965. State of Texas. US Geological Survey, Denver CO, 4 sheets.

US Department of the Interior, Bureau of Land Reclamation. 1970. The impact of power transmission lines. Washington DC, variously paged.

US Department of the Interior, Heritage Conservation and Recreation Service. 1979. National Register of Historic Places: annual listing of historic properties. Federal Register Vol. 44, No. 26, pt. 2, pp. 7415-7649.

_________. 1980. National Register of Historic Places: annual listing of historic properties. Federal Register Vol. 45, No. 54, pt. 2, pp. 17447-17519.

_________. 1981. National Register of Historic Places: annual listing of historic properties. Federal Register Vol. 46, No. 22, pt. 2, pp. 10622-10679.

US Environmental Protection Agency. 1974a. Development document for effluent limitations guidelines and new source performance standards for the steam electric power generating point source category. Washington DC, EPA 440/ 1-74/029a, group 1, variously paged.

__________. 1974b. Levels of environmental noise requisite to protect health and welfare with an adequate margin of safety. Washington DC, EPA 550/9-74-004, variously paged.

__________. 1975a. Effluent guidelines and standards for the steam electric power generating point source category: final standards of performance for new sources. Washington DC, 40 CFR 423-15, variously paged.

__________. 1975b. Final regulations for preparation of environmental impact statements. Washington DC, 40 CFR Chapter 1, Part 6, variously paged.

__________. 1976a. Development document for best available technology available for the location, design, construction and capacity of cooling water intake structures for minimizing adverse environmental impact. Washington DC, EPA 440/1-76/105a, variously paged.

__________. 1976b. Erosion and sediment control, surface mining in the eastern United States, planning and design. US Government Printing Office, Washington DC, EPA-625/3-76-006, 238 p.

__________. 1976c. Quality criteria for water. Washington DC, 501 p.

__________. 1977a. Accidents and unscheduled events associated with non-nuclear energy resources and technology. Office of Research and Development, US Environmental Protection Agency, Washington DC, EPA-600/ 7-77-016, variously paged.

__________. 1977b. Regulations for the preparation of environmental impact statement -- new sources NPDES permits. Washington DC, 42 FR 7 (11 January 1977), pp. 2450-2459.

__________. 1978a. Protective noise levels. Washington DC, EPA 550/9-79-100, variously paged.

__________. 1978b. Source assessment: coal storage piles. Cincinnati OH, EPA-600/2-78-004K, variously paged.

__________. 1978c. Survey of fugitive dust from coal mines. Washington DC, variously paged.

__________. 1979a. Effluent guidelines and standards for the coal mining point source category: final standards for performance for new sources. Washington DC, 40 CFR 434, (12 January 1979), 44 FR 9:2586-2592.

__________. 1979b. Final regulations regarding the National Pollution Discharge Elimination System. Washington DC, 50 CFR Parts 121, 122, 124, 125, variously paged.

__________. 1979c. Working guidelines for the preparation of environmental impact statements. Memo, C.B. Spotts, US Environmental Protection Agency, Region 6 to EIS preparers August 1979, Dallas TX, variously paged.

__________. 1980. Radiological impact caused by emissions of radionuclides into air in the US, preliminary report. Office of Radiation Programs, Washington DC, EPA 520/7-79-006, variously paged.

__________. 1981a. Draft environmental impact statement, Limestone electric generating station and Jewett Mine in Freestone, Limestone, and Leon Counties, Texas. Dallas TX, variously paged.

__________. 1981b. Environmental impact statement, Limestone electric generating station and Jewett Mine in Freestone, Limestone, and Leon Counties, Texas. Dallas TX, variously paged.

__________. 1981c. Approval and promulgation of implementation plans. 40 CFR Part 52.21, pp. 20-27.

__________. 1981d. National primary and secondary ambient air quality standards. 40 CFR Part 50, pp. 531-582.

__________. 1981e. Standard of performance for coal preparation plants. 40 CFR Part 60, Subpart Y, pp. 265-267.

__________. 1981f. Standard of performance for fossil-fuel-fired steam generator. 40 CFR Part 60, Subpart D, pp. 206-213.

__________. 1981g. Steam electric power generating point source category. 40 CFR Part 400-424, 662 p.

US Fish and Wildlife Service. 1978. Impacts of coal-fired power plants on fish, wildlife and their habitats. Washington DC, FWS/OBS-78/29, 259 p.

__________. 1980. Endangered species of Texas and Oklahoma. Region 2, Endangered Species Office, Albuquerque NM, 92 p.

US Forest Service, Intermountain Forest and Range Experiment Station. 1980. User guide to hydrology; mining and reclamation in the west. General technical report INT-74. US Department of Agriculture, Ogden UT, 64 p.

US General Accounting. 1981. Coal and nuclear wastes -- both potential contributors to environmental and health problems. Washington DC, variously paged.

US Geological Survey. 1980. Water resources data for Texas. Vol. 2. San Jacinto River Basin, Brazos River Basin, San Bernard River Basin, and intervening Coastal Basin, Austin TX, variously paged.

__________. 1981. WATer data STOrage and REtrieval (WATSTORE). Dallas TX, computer printout, variously paged.

Urban Systems Research and Engineering, Inc. 1980. Induced impacts of new source industries: study and EIS preparation manual development. Prepared for US Environmental Protection Agency. Washington DC, variously paged.

URS/Forrest and Cotton, Inc. 1974. Oak Knoll Dam and Reservoir on Steele Creek, Brazos River Basin, Limestone County, Texas, and Twin Oak Dam and Reservoir on Duck Creek, Brazos River Basin, Robertson County, Texas. Prepared for presentation at the Public Hearing. Texas Water Rights Commission, Austin TX, variously paged.

WAPORA, Inc. 1978. Environmental impact assessment guidelines for new source surface coal mines. Prepared for US Environmental Protection Agency. Washington DC, 155 p.

__________. 1979. Environmental assessment guidelines for new source fossil-fueled steam electric generating stations. Prepared for US Environmental Protection Agency. Washington DC, 144 p.

__________. 1981. Areawide environmental inventory report on coal/lignite mining and associated power plants and industrial development in portions of Arkansas, Louisiana, Texas, Oklahoma, and New Mexico. Dallas TX, variously paged.

Wegley, Jennifer L. 1981. Letter, Jennifer L. Wegley, Central Texas Council of Governments, to WAPORA, Inc., 6 October 1981, 4 p.

White, David M. and Olin B. Clemons. 1977. Coal and lignite: Mining, transportation, and utilization needs for Texas. The Governor's Energy Advisory Council, Austin TX, 352 p.

Whitmore, F.C., and R.L. Durfee. 1973. Determination of coronal ozone production of high voltage transmission lines. US Environmental Protection Agency, Washington DC, EPA-650/4-73-003, variously paged.

Yates, Sandy. 1981. Phone, Sandy Yates, Texas Railroad Commission, 3 April 1981.

CHAPTER 10.0
GLOSSARY

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ACFM. Actual cubic feet per minute.

Acid Rain. Specifically, rain of low pH (usually less than 5.7) that has been postulated to have many detrimental effects on calcareous structures or on aquatic and terrestrial systems in areas with low buffering capacity. Caused by airborne gases and soluble particles that form acids in rainwater, either emitted from man-made (industrial, automobiles) or natural (fires, volcanoes) sources. In general use, includes dry deposition of acidifying materials as well.

Acoustic Center. A point source that is the sum of the sound levels of all sources that radiate in the direction of the receiver. When the distance from the plant to a receiver is more than twice the distance between the most spearated major sources of plant, the plant can be considered as a point source.

Acre-foot. The volume of water necessary to cover one acre to a depth of one foot (equal to 43,450 cubic feet).

ALCOA. Aluminum Company of America.

Algal Bloom. A pulse in the population density of algae in a water body caused usually by the occurrence of optimal conditions for a few species. Frequently used in negative sense to refer to conditions in which populations reach nuisance levels, producing surface scums, taste and odor problems, and/or dissolved oxygen depletion. Can cause fish kills.

Alluvial. Relating to clay, silt, sand, gravel, or similar detrital material deposited by running water.

Ambient. The surrounding environment or atmosphere.

Ancillary. Subsidiary or supplementary.

Aquatic Macrophyte. Larger aquatic plants.

Aquifer. A water-bearing stratum of permeable rock, sand, or gravel.

Atmospheric Inversion. A condition which occurs when the air near the earth is cooler than the air above. The result is a stable atmosphere in which layers do not mix and ground level air becomes stagnant (also see Temperature Inversion).

BACT. An acronym for Best Available Control Technology. A regulatory air pollutant emissions limitation based on the maximum degree of reduction of a particular pollutant, taking into account energy, environmental, and economic impacts.

Baseline. Existing condtions.

Benthic. Bottom dwelling.

Berm. A narrow shelf, path, or ledge at the top or bottom of a slope.

Biomass. The amount of living matter, as in a unit area or volume of habitat.

Boiler Blowdown. Method of preventing buildup of naturally occurring solids found in boiler feedwater. Also known as "Demineralizer Blowdown".

Bottom Ash. Coal ash that either settles or adheres to the interior furnace surfaces in the form of fine particulate or sludge.

BP. Before Present; indicates time in radiocarbon years before AD 1950.

BRA. Brazos River Authority.

Chlorination. The application of chlorine to water or wastewater, generally for the purpose of disinfection, but frequently for accomplishing chemical results, such as oxidation of odor-producing compounds.

CO. Carbon monoxide.

COE. Corps of Engineers.

Conductivity. The ability to carry an electrical charge, in ions. The conductivity of aqueous solutions is increased by dissolved salts and thus is a measure of the amount of ionized salts in solution.

Convection. The transfer of heat by automatic circulation of a liquid at a nonuniform temperature.

Convection Showers. Precipitation falling from clouds induced by the solar heating of moist, unstable air.

Cubic feet per second (cfs). Units used to measure flow at a gauging station; equals the rate of flow in a channel with a one-square-foot cross-section and velocity of one foot per second. One cfs for a 24-hour period equals 86,400 cubic feet or 1.98 acre-feet.

dBA. The sound level obtained by the use of A-weighting. The unit is the decibel, dB, and is followed by the letter A to indicate A-weighting. The A-weighting network best simulates the human ear's response to sound pressure.

Decibel. An unit of intensity of sound.

Dewater. Removal of water. Removal of groundwater and lowering of the water-table for the purposes of mining.

Dip (of sedimentary structures). The downward inclination of a vein or stratum with reference to a horizontal plane.

Dissolved Oxygen (DO). In the course of breaking down excess organic matter in water, microbes may deplete the oxygen, causing stress from lack of oxygen on fish and other aquatic life.

Dissolved Solids (also total dissolved solids - TDS). Solid material dissolved in a liquid.

Diversions. The amount of water taken from a stream (or spring, well); also called withdrawals.

Drag-line. An excavation machine having a bucket that is dropped from a boom and dragged toward the machine by a cable.

EBI. Effective buying income.

Ecosystem. A community and its environment treated together as a functional system of complimentary relationships involving the transfer and circulation of energy and matter.

Ecotone. The boundary line or transitional area between two adjacent ecological communities usually exhibiting competition between organisms common to both.

Effluent. Wastewater or other liquid, partially or completely treated, flowing out of a reservoir, basin or treatment plant.

EID. Environmental Information Document.

EIS. Environmental Impact Statement.

Electostic Precipitator. A device that uses an electrical charge to remove particulates from an effluunt airstream.

Emissions. Substances ejected or discharged to the environment.

End Lake. Last active mining pit; not backfilled, but allowed to fill with water from rain and cessation of dewatering.

Entrainment. Incorporation of organisms into water that flows through an industrial process (as in the cooling water of a power generating station) and are subsequently discharged. Entrainment effects may be incurred from mechanical impacts, turbulence, abrasion, and heat among other factors.

EPA (or USEPA). United States Environmental Protection Agency.

Ephemeral. Short-lived; taking place once only. An ephemeral stream may flow only at certain times of the year.

ERCOT. Electrical Reliability Council of Texas.

ESP. Electrostatic precipitators.

Eutrophic. Rich in dissolved nutrients, but often shallow and with seasonal oxygen deficiency.

Evaporation. A physical process by which a liquid is transformed into a gaseous state.

Fecal Coliforms. A large and varied group of bacteria flourishing in the intestines and feces of warm-blooded animals, including man. Large amounts of these bacteria in the water indicate sewage or feedlot pollution.

FGD (flue gas desulfurization). Any process that removes sulfur containing compounds from the flue gas.

Fixed Ash. Fly ash that has been processed with FGD sludge to create a product that is easier to dispose than the powdery fly ash and that is suitable for landfilling.

Fixed Waste. Waste products that have been processed with one or more chemical additives to stabilize the untreated waste in order to improve its chemical and/or physical properties for ponding or landfill disposal.

Floodplain. Level land that may be submerged by floodwaters; or a plain built up by stream deposition.

Floristics. A branch of phytogeography that deals numerically with plants and plant groups.

Flue Gas. Any gas that is ducted through flue or chimney and expelled to the atmosphere.

Fluvial. Relating to, or produced by stream or river action.

Fly Ash. Coal ash particulate matter that is entrained into the flue gas stream.

Formation. A body of rocks or sediment classed as a unit for geologic mapping.

Fugitive Dust. Dust emissions which cannot be traced to a particular source (e.g., dust generated by vehicles on roads).

Fugitive Emissions. Air pollutant emissions that cannot be traced to a particular point or stack.

FWPCA. Federal Water Pollution Control Act.

Gasification. To convert into gas.

GLC (ground level concentration). Pollutant concentrations at ground level at some distance away from the source measured in micrograms per cubic meter.

GPM. Gallons per minute.

HC. Hydrogen chloride.

Heavy Metals. Soluble trace elements found in the coal that tend to concentrate in the waste by products and that are leachable and potentially toxic.

Heterogeneity. The quality or state of consisting of dissimilar ingredients or constituents.

Herpetofauna. Reptiles and amphibians.

HL&P. Houston Lighting & Power.

Hydraulic Conductivity. Ratio of flow velocity to driving force for viscous flow under saturated conditions of a specified liquid in a porous medium.

Hydrology. A science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rocks, and in the atomosphere.

Impingement. The capture and retention of aquatic organisms on screening structures at the water intake point of a facility.

Induced Employment. New jobs resulting from increased economic activity in an area.

Infiltration. To enter, permeate, or pass through a substance or area by filtering gradually.

Infrastructure. The underlying foundation or basic framework, as in a system or organization.

In-migration. Movement of population into a community or region.

Interior Drilling. Drilling of subsurface deposits to determine horizontal and vertical extent of lignite.

$L_{(dn)}$. Day-Night Sound Level. The 24-hour equivalent sound level with a penalty value of 10 dBA added to the average levels occurring during the nightime hours of 10:00 p.m. to 7:00 a.m.

Leachate (acid leachate). Liquid that has percolated through a medium and has extracted dissolved or suspended materials from it.

Lentic. Standing water.

Lignite. A brownish-black coal in which the alternation of vegetal matter has proceeded further than peat, but so far as sub-bituminous coal.

Liquor. Any liquid substance, or solution of a substance.

Lithological. Pertaining to the study of rocks and rock formations.

Littoral. Relating to the shore.

Loam. A rich, friable soil containing a relatively equal mixture or sand and silt and a somewhat smaller proportion of clay.

Long-term. Occurring over or involving a relatively long period of time.

Lotic. Running water.

Mean Value. Average of all sample values.

Median Value. A value at which half the sample values are higher and half lower.

Megawatt (gross) MW. The total amount of power that is produced in a power plant including that used by the plant itself.

Megawatt (net) MW. The amount of power that is transmitted from a power plant.

MGD (million gallons per day). Expresses the flow rate of water through a certain point.

MG/L (milligrams per liter). One part by weight of dissolved chemical, or suspended sediment, in 7 million parts by volume (= 1 liter) of water. (see parts per million).

Microbiocides. A substance that is destructive to many different organisms, microorganisms in particular.

Mitigate. To make less harsh or severe.

Monitoring. Periodic or continuous determination of the amount of pollutants present in the environment.

Monoculture. Single species habitat.

MSL (mean sea level). The average height of the sea for all stages of the tide.

MSHA. Mine Safety and Health Administration.

MW. Megawatt.

NAAQS. National Ambient Air Quality Standards.

NEPA. National Environmental Policy Act.

NERC. National Electric Reliability Council.

NESC. National Electric Safety Code.

NO_2. Nitrogen dioxide. A gaseous atmospheric pollutant formed primarily during combustion of fossil fuels.

NO_x. A combination of various oxides of nitrogen, the most common of which are nitric oxide (NO) and nitrogen dioxide (NO_2). Formed by combustion processes.

NPDES (National Pollutant Discharge Elimination System). The permitting system authorized under Section 402 of the Clean Water Act, including any state or interstate program that has been approved by the Administrator, in whole or in part, pursuant to Section 402.

NSPS. New Source Performance Standards.

Old Field Habitat. Undisturbed grassland/shrub habitat.

OSHA. Occupational Safety and Health Administration.

Outcrop. The part of a vein or stratum that is visible at the surface of the earth.

Outfalls. Pipes for the discharge of treated wastewater to the reservoir.

Overburden. Material of any nature, consolidated or unconsolidated, that overlies a deposit of useful minerals, ores, or coal; especially those mined from the surface.

Ozone. A form of oxygen (O_3) produced when electricity passes through air.

Parameter. One of a series of independent variables in a system.

Particulates. Small particles of solid or liquid materials that, when suspended in the atmosphere, constitute an atmospheric pollutant.

P-E Index. Precipitation-Evaporation Index. A numerical value, based on humidity, precipitation, and temperature, to describe the amount of moisture entering and leaving an area.

Permeability. A quality of having pores or openings that permit liquids or gases to pass through.

pH. The measure of hydrogen-ion activity in solution. Expressed on a scale of 0 (highly acid) to 14 (alkaline) pH 7.0 is a neutral solution, neither acid nor alkaline.

Phytoplankton. Tiny plant like organisms which float or drift in water.

Polyelectrolyte. A high polymer substance, either natural or synthetic, containing ionic constituents; they may be either cationic or anionic.

Porosity (of overburden). The ratio of the aggregate volume of interstices (pore, void) in a rock or soil to its total volumes. It is usually stated as a percentage.

PPM (parts per million). One part by weight of dissolved chemical or suspended sediment in one million parts by weight of water.

Precipitators. Used to handle large volumes of gases from which microscopic size solid or liquid particles (such as smoke, fog, or mist) must be removed.

PSD. Prevention of Significant Deterioration.

PUC. Public Utilities Commission.

Radionuclide. A radioactive species of atom characterized by the energy level and the number of protons and neutrons contained in its nucleus.

Prime Farmland. Land that has been in cultivation 5 of the last 10 years.

Radiation. The emission of energy in the form of waves or particles.

RCRA. Resource Conservation and Recovery Act.

Reclamation. Restoration to the original or some other use.

Retention Pond. (see settling pond)

Revegetation. New vegetative cover.

Riparian. Relating to the bank of a natural water course, such as a river, lake, or stream.

Riprap. A foundation or wall of stones thrown together irregularly.

Runoff. The portion of the precipitation on the land that ultimately reaches a stream(s), especially from rain that flows over the surface.

SCS. Soil Conservation Service.

SES. Steam electric station.

Settling Pond. A large shallow body of water into which industrial wastewaters are discharged. Suspended solids settle from the wastewaters due to the large retention time of water in the pond.

Scrubbers. An apparatus for removing impurities, especially from gases.

Sediment Control. The planning and construction of facilities for prevention of excessive damage by water in flood stages.

Short-term. Occurring or involving a short period of time.

Sludge. A concentrate in the form of a semi-liquid mass deposited as a result of waste treatment.

Slurry. A suspension of a solid in a liquid.

SO_2. Sulfur dioxide - a gaseous air pollutant that is produced primarily by the combustion of fossil fuels and petroleum refining.

Spoil Piles. Piles of debris or waste material from a coal mine.

Stagnating Anticyclone. An area of slow-moving high pressure, dominated by light winds and limited vertical dispersion of pollutants.

Subcrop Drilling. A testing program to determine the location and areal extent of minor lignite deposits.

Subsidence. A sinking of a large part of the earth's crust.

Surge Pond. Ponds designed to accommodate the surge of water resulting from gate closures on discharge pipelines.

Suspended Solids. Particles of solid materials suspended in a liquid (also see TSS - Total Suspended Solids).

TACB. Texas Air Control Board.

TAS. Texas Archaeological Survey.

Taxon (pl. taxa). A group or entity within the orderly classification of plants and animals according to their presumed natural relationships.

TDH. Texas Department of Health.

TDHPT. Texas Department of Highways and Public Transportation.

TDS (total dissolved solids). The anhydrous residues of dissolved constituents in water. Actually, the term is defined by the method used in determination. Standard Methods are used in water and wastewater treatment.

TDWR. Texas Department of Water Resources.

Temperature Inversion. A stable layer in the atmosphere in which temperature increases with altitude. (also see Atmospheric Inversion).

TMPA. Texas Municipal Power Authority.

TOSES. Twin Oak Steam Electric Station.

Topography. The configuration of a surface including its relief and position of its natural and man-made features.

TP&L. Texas Power & Light.

TPWD. Texas Parks and Wildlife Department.

TRC. Texas Railroad Commission.

Trophic Levels. A certain nutrition level in the food chain defined by the source of food for cratures of that level.

TSP (total suspended particulates). Existing in the form of minute separate particles. Suspended particulate is measured by drawing a known volume of air through a filter and weighing the filter, both before and after.

TSS (total suspended solids). The sum of solids that either float on the surface or are in suspension in water, wastewater, or other liquids. These can be removed by filtering.

TUCS. Texas Utilties Company System.

TUFCO. Texas Utilities Fuel Company.

TUGCO. Texas Utilities Generating Company.

Turbidity. Defined as capacity of material suspended in water to scatter light. Highly turbid water is often called "muddy", although all manner of suspended particles contribute to turbidity.

TUSI. Texas Utilities Services, Inc.

USFWS. United States Fish and Wildlife Service.

USGS. United States Geologic Survey.

Waste Slurry. A watery mixture produced by flue gas cleaning to remove SO_2 from the flue gas and that contains only 5-15 percent solids prior to dewatering.

Wastewater. The spent water of a plant or a community. A combination of liquid and water-carried wastes from residences, commercial buildings, industrial plants, and/or institutions.

Watershed. A region or area bounded peripherally by a water parting and draining ultimately to a particular watercourse or body of water.

Wind Rose. A map symbol showing, for a given locality or area, the frequency and strength of the wind from various directions.

"Worst Case". A situation in which the combination of factors that would produce the worst potential impact on the environment.

WRC. Texas Water Rights Commission.

Zooplankton. Tiny animal-like organisms which float or drift in water.

CHAPTER 11.0

APPENDICES

APPENDIX A

SIGNIFICANT CORRESPONDENCE

RAILROAD COMMISSION OF TEXAS
SURFACE MINING AND RECLAMATION DIVISION

JAMES E. (JIM) NUGENT, Chairman
MACK WALLACE, Commissioner
BUDDY TEMPLE, Commissioner

J. RANDEL (JERRY) HILL
Director
CHESLEY N. BLEVINS
Assistant Director

105 W. RIVERSIDE DRIVE CAPITOL STATION — P. O. DRAWER 12967 AUSTIN, TEXAS 78711

July 14, 1981

RE: Texas Utilities Generating
Company
Twin Oak Steam Electric
Station

RECEIVED
JUL 17 1981
S & A DIVISION

Mr. Clinton B. Spotts
Regional EIS Coordinator
U. S. Environmental Protection
Agency
Region VI
1201 Elm Street
Dallas, Texas 75270

Dear Mr. Spotts:

I have received your letter dated July 3, 1981, in which you discuss the Texas Utilities Generating Company (Twin Oak) proposed power plant to be located in Robertson County. The lignite mine to be developed to supply fuel for the plant would also be located in Robertson County and operated by Texas Utilities.

Your letter specifically requests agencies wishing to cooperate in the project review to notify you in writing. The Railroad Commission of Texas' Surface Mining and Reclamation Division wants to participate in the process, at least to the extent that such review might in any way affect the Texas Utilities mining operation.

As you are probably aware, pursuant to the federal Surface Mining Control and Reclamation Act of 1977, the Railroad Commission of Texas is the exclusive permitting and regulatory authority for surface coal mining operations in this state. The Texas Utilities mining operation must be reviewed in detail by our staff and permitted prior to commencement of any

An Equal Opportunity Employer

mining activities. This review is very detailed and requires the submission by Texas Utilities of an application which addresses water resources, hydrology, wildlife, vegetation, mining and reclamation techniques, and a myriad of other related areas.

In the interest of avoiding duplicitous review of the mining operation, the Surface Mining Division would like to conduct its review as a cooperating agency in conjunction with its review as Regulatory Authority. This would also assure that any comments we might have are based on complete information which is required by the state as a part of any mining application. To the extent that the Railroad Commission does participate in the review process, we would ask that our comments be made a part of the official administrative record.

Please let me know if there is anything further you need from us at this time.

Sincerely,

J Randel (Jerry) Hill

J. Randel (Jerry) Hill
Director

JRH/csp

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

SE

POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

RECEIVED
OCT 26 1981
S & A DIVISION

October 21, 1981

Mr. Clinton B. Spotts
Regional EIS Coordinator
U.S. Environmental Protection Agency
1201 Elm Street
Dallas, Texas 75270

Dear Mr. Spotts:

This is in reply to your letter of August 4, 1981, (received October 16, 1981) which requested information about species which are listed or proposed to be listed as threatened or endangered, as provided by the Endangered Species Act. Your area of interest is the Twin Oaks Steam Electric Station, Robertson County, Texas.

As provided by Section 7(c)(1) of the Endangered Species Act, the Fish and Wildlife Service is required to furnish a list of those species, both proposed and listed, that may be affected by Federal construction activities.

Upon receipt of the Fish and Wildlife Service's species list, the Federal agency authorizing, funding or carrying out the construction action is required to conduct a biological assessment for the purpose of identifying listed and proposed species which are likely to be affected by such action.

The biological assessment shall be completed within 180 days after receipt of the species list, unless it is mutually agreed to extend this period. If the assessment is not initiated within 90 days after receipt of the species list, I suggest its accuracy be verified before conducting the assessment.

Biological assessments should include as a minimum:

1) an onsite inspection of the area affected by the proposed activity or program, which may include a detailed survey of the area to determine if species are present and whether suitable habitat exists for either expanding the existing population or potential reintroductions of populations;

2) interview recognized experts on the species at issue, including the Fish and Wildlife Service, State conservation departments, universities, and others who may have data not yet found in scientific literature;

3) review literature and other scientific data to determine the species distribution, habitat needs, and other biological requirements;

4) review and analyze the effects of the proposal on the species, in terms of individuals and populations, including consideration of the cumulative effects of the proposal on the species and its habitat;

5) analyze alternative actions that may provide conservation actions;

6) other relevant information;

7) report documenting the assessment results.

As you will recall from the recent consultation on Limestone Electric Generating Station, we are very concerned about the impacts of acid precipitation from increasing numbers of coal-fired electric generating stations in East Texas. Therefore, please include a complete analysis of Twin Oaks Steam Electric Station's impact on air quality in the biological assessment.

For purposes of providing interim guidance, the Fish and Wildlife Service considers construction projects to be any major Federal action authorized, funded or carried out by a Federal action which significantly affects the quality of the human environment and which is designed primarily to result in the building or erection of man-made structures such as dams, buildings, roads, pipelines, channels, and the like.

If the biological assessment indicates the proposed project may affect listed species, the formal consultation process shall be initiated by writing to the Regional Director, Region 2, U.S. Fish and Wildlife Service, P.O. Box 1306, Albuquerque, New Mexico 87103. If no effect is evident, there is no need for further consultation. I would, however, appreciate the opportunity to review your biological assessment.

In addition, the Act (Sec. 7(c)(1)) now requires Federal agencies to confer with the Service on any agency action which is likely to jeopardize the continued existence of any species proposed to be listed as endangered or threatened or adversely modify critical habitat proposed to be designated for such species. The purpose of this requirement is to identify and resolve at the early planning stage of an action, all potential conflicts between the action and the respective species and critical habitat. The informal consultation process can accomplish this requirement.

The attached sheet provides information on listed species which may occur in the area of interest. If you have need of further assistance, please call the Office of Endangered Species at (505) 766-3972 or FTS 474-3972.

Sincerely yours,

Acting
Deputy Regional Director

Attachment

cc: Austin Area Office, Austin, Texas
Ecological Services Field Office, Fort Worth, Texas

Twin Oaks Steam Electric Station
Robertson County, Texas

LISTED SPECIES

Bald eagle (Haliaeetus leucocephalus) - may occur statewide as wintering populations on larger bodies of water during November-March.

Attwater's prairie chicken (Tympanuchus cupido attwateri) - is a medium-sized grouse of tall-grass coastal prairies.

Whooping crane (Grus americana) - is a very large, white bird (wing span 7.5 ft.) with long neck and long legs that normally trail behind the body in flight; whoopers migrate through Central Texas in fall and spring and utilize marshes, river bottoms, and prairies.

Red-cockaded woodpecker (Picoides borealis) - is a "zebra-backed" woodpecker with a solid black cap and nape and prominent white cheekpatch. The male has a small red streak (cockade) behind the eye near the ear. This woodpecker inhabits mature (50+ years) pine forests.

American alligator (Alligator mississippiensis) - is endangered in East Texas, except the coastal counties, and may occur in association with any permanent water or marsh.

Houston toad (Bufo houstonensis) - is a small toad similar in appearance to the American toad, but with large postorbital crests that are heavier than the interorbital crests. Its habitat includes sandy areas with temporary ponds during the spring rains; this species could be expected to be sensitive to acid precipitation.

PROPOSED SPECIES

Spiranthes parksii - is an orchid occurring in nearby Brazos County and is a species that is very sensitive to change in soil pH.

CRITICAL HABITAT

The designated critical habitat of Bufo houstonensis is immediately south of Robertson County in Burleson County.

IN REPLY REFER TO:
SE

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE

POST OFFICE BOX 1306
ALBUQUERQUE, NEW MEXICO 87103

April 14, 1982

RECEIVED
APR 19 1982
6 ES

Mr. Clinton B. Spotts
U.S. Environmental Protection Agency
1201 Elm Street
Dallas, Texas 75270

Dear Mr. Spotts:

The Regional Office of Endangered Species has reviewed the biological assessment dated March 11, 1982, for issuance of a new source National Pollutant Discharge Elimination System (NPDES) permit for the Twin Oak Steam Electric Station (TOSES) in Robertson County, Texas. We concur with your conclusion that issuance of the NPDES permit for TOSES will not affect any listed endangered or threatened species.

However, your cover letter dated March 30, 1982, states that EPA already issued an NPDES permit (effective November 28, 1981) for the lignite mine located near the TOSES. We are interested in reviewing your evaluation that indicated threatened and endangered species will not be affected as a result of the NPDES permit.

In our letter of February 16, 1982, we suggested that a meeting between your staff and representatives of my Section 7 staff would provide a basis for expediting future Section 7 consultations. We still believe such a meeting would be worthwhile; therefore, we suggest that Messrs. Gary Halvorson and David Bowman meet with you and your staff in early May to discuss Section 7 consultation procedures. Please designate someone with whom a specific date(s) and agenda can be arranged.

Thank you for the opportunity to review the biological assessment.

Sincerely yours,

Gordon H Hansen

Acting Regional Director

cc: Area Manager, Austin Area Office, Austin, TX
Field Supervisor, Fort Worth Ecological Services, Fort Worth, TX

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MRS. MENTON MURRAY, SR., HARLINGEN
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DR. DAN A. WILLIS, HOUSTON

TEXAS HISTORICAL COMMISSION

P.O. BOX 12276
AUSTIN TEXAS 78711

TELEPHONE
(512) 475-3092

February 1, 1982

RECEIVED
FEB 2 1982
6 ES

Mr. Clinton B. Spotts
Regional EIS Coordinator
U.S. Environmental Protection
Agency
Region VI
1201 Elm Street
Dallas, Texas 75270

Re: Twin Oak Steam Electric Station
and Associated Ancillary Facilities

Dear Mr. Spotts:

We have received your letter of January 7, 1982, concerning the undertaking referenced above. We have received the latest transmission line study from the Texas Archeological Survey (see our letter of January 5, 1982 attached).

The compliance procedure for Section 106 of the National Historic Preservation Act and attendant Federal regulations have been accomplished for the Twin Oak Steam Electric Station and Associated Ancillary Facilties (i.e., make-up water pipeline, railroad spur line and transmission line corridors). We concur with EPA's determination of no effect.

Sincerely,

Curtis Tunnell
Acting State Historic Preservation
Officer

by

LaVerne Herrington

LaVerne Herrington, Ph.D.
Director
Resource Conservation

PEP/LH/lft

Enclosure

cc: TP&L, Bob Almond w/encl.

The State Agency for Historic Preservation

[illegible] SR., SOMERVILLE
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TEXAS HISTORICAL COMMISSION

P.O. BOX 12276
AUSTIN TEXAS 78711

TELEPHONE
(512) 475-3092

January 5, 198~~1~~2

Solveig A. Turpin
Assistant Director
The University of Texas
at Austin
Texas Archeological Survey
Austin, Texas 78758

Re: Texas Power and Light Lake
Creek-Jewett-Twin Oak
Transmission Corridor

Dear Ms. Turpin:

We have received and reviewed the report concerning the undertaking referenced above. We concur with the findings of the archeologist, i.e., the undertaking should not affect sites on the National Register of Historic Places, nor any site eligible for the Register. However, should cultural resources be encountered during any construction, including the unsurveyed one-half mile segment, work will cease and the SHPO and the Advisory Council will be afforded the opportunity to comment in accordance with 36 C.F.R., Part 800, Procedures for the Protection of Historic and Cultural Properties.

Thank you for the opportunity to participate in the review process.

Sincerely,

Curtis Tunnell
Acting State Historic Preservation
Officer

by

LaVerne Herrington
LaVerne Herrington, Ph.D.
Director
Resource Conservation

PEP/LH/lft

cc: TP&L, Bob Almond
EPA, Dallas Office

The State Agency for Historic Preservation

APPENDIX B

AIR QUALITY

APPENDIX B - AIR QUALITY

SPECIFIC CONDITIONS ASSOCIATED WITH THE PSD PERMIT

(1) The source will be constructed in accordance with the application and supportive facts submitted for EPA review.

(2) The source shall meet the requirements for the application of best available control technology as follows:

a. The source shall comply with the requirements of the New Source Performance Standards (NSPS) for Solid Fossil Fuel-Fired Steam Generators (40 CFR, Part 60, Subpart D) except that the maximum emissions of SO_2 shall be 1.08 $lb/10^6$ BTU heat input as opposed to 1.2 $lb/10^6$ BTU that is specified in the NSPS.

b. The source shall comply with the NSPS for Coal Preparation Plants (40 CFR Part 60, Subpart Y).

(3) The maximum emission rates of SO_2 and TSP from the two 750 MW lignite-fired units taken together shall not exceed 17,058 lb SO_2/hr and 1,586 lb TSP/hr.

(4) The source will comply with the test methods and procedures as outlined in 40 CFR 60.46.

SPECIAL PROVISIONS ASSOCIATED WITH THE TEXAS AIR CONTROL BOARD (TACB) PERMIT FOR THE STEAM ELECTRIC GENERATORS

(1) Operation, monitoring, recording and testing of the facility shall comply with EPA regulations on Standards of Performance for New Stationary Sources existing for fossil fuel-fired steam generators in 40 CFR Part 60.

(2) Maximum emissions of sulfur dioxide shall not exceed 1.08 $lb/10^6$ BTU heat input.

(3) Maximum emissions of nitric oxides shall not exceed 4752 lb/hr.

(4) Maximum emissions of particulates shall not exceed 792 lb/hr.

(5) Opacity of emissions from the boiler stack must not exceed 20%, averaged over a 5-minute period, except for those periods described in Rule 131.03.03.001 of Regulation I (e.g., cleaning the firebox, equipment changes, ash removal).

(6) The holder of this permit shall forward to the staff of the TACB more detailed engineering data on the particulate and sulfur dioxide abatement equipment as it becomes available. Operation of the boiler shall not begin until the approved abatement equipment has been installed.

(7) The holder of this permit shall forward to the staff of the TACB more detailed engineering data on the boiler design as it becomes available. In no event shall construction of the boiler, excluding its foundation, begin until the staff has reviewed and the Executive Director has approved the final detailed engineering data.

(8) Sampling ports and platform(s) shall be incorporated into the design of the boiler stack according to the specifications set forth in "Chapter 2, Stack Sampling Facilities." Alternate sampling designs may be submitted for approval by the Executive Director of the TACB.

(9) A copy of all sampling reports shall be furnished to the Executive Director of the TACB within 60 days after completion of sampling.

(10) Plant roads shall be paved and cleaned, oiled or sprinkled with water and/or chemicals as necessary to control the emission of dust to minimum level possible under existing conditions.

(11) Upon a determination that existing and proposed emissions in the vicinity of this facility will create ambient concentrations of air contaminants in excess of those permitted by Part C of the Federal Clean Air Act as amended, the Executive Director may elect to require, by amendment to this permit, the installation of additional abatement equipment on the facility permitted herein.

(12) This permit may be appealed pursuant to Section 6.01 of the Texas Clean Air Act and Rule 56.1 of the Procedural Rules of the TACB. Failure to take such appeal constitutes acceptance by the applicant of all provisions and special conditions contained in or attached to the permit.

SPECIAL PROVISIONS ASSOCIATED WITH THE TACB PERMIT FOR THE LIGNITE HANDLING SYSTEM

(1) Operation, monitoring, recording, and testing of the facility shall comply with EPA regulations on Standards of Performance for New Stationary Sources existing for coal preparation plants in 40 CFR 60, Subpart Y.

(2) Opacity of emissions from the lignite handling facility must not exceed 20%, averaged over a 5-minute period except for those periods described in Rule 131.03.03.001 of Regulation I (e.g., cleaning the firebox, equipment changes, ash removal).

(3) The holder of this permit shall demonstrate that all hooding, duct and collection systems are effective in capturing emissions from this equipment and in preventing fugitive emissions from buildings.

(4) Lignite stockpiles shall be sprinkled with water and/or chemicals as necessary to control the emission of dust to the minimum level possible under existing conditions.

(5) All lignite conveyor belts shall be covered where possible.

(6) The total emissions of particulate matter from any of the sources shall not exceed 10 lb/hr or 43.8 tons/year.

(7) Emission limitations specified are based on an operating schedule of 8760 hours per year.

SPECIAL PROVISIONS ASSOCIATED WITH THE PERMIT FOR THE FLY ASH HANDLING SYSTEM

(1) Disposal of ash must be accomplished in a manner which will prevent the ash from becoming airborne.

(2) Opacity of emissions from the ash handling system must not exceed 20%, averaged over a 5-minute period, except for those periods described in Rule 131.03.03.001 of Regulation I (e.g., cleaning the firebox, equipment changes, ash removal).

(3) The holder of this permit shall forward to the staff of the TACB more detailed engineering data on the abatement equipment as it becomes available. In no event shall construction of the abatement equipment begin until the staff has reviewed and the Executive Director has approved the final detailed engineering data. Operation of the ash handling system shall not begin until the approved abatement equipment has been installed.

(4) The holder of this permit shall demonstrate that all hooding, duct and collection systems are effective in capturing emissions from this equipment and in preventing fugitive emissions from buildings.

(5) The total emissions of particulate matter from any of the sources shall not exceed 10 lb/hr or 43.8 tons/year.

(6) Emission limitations specified are based on an operating schedule of 8,760 hours per year.

APPENDIX C

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

Permit No. TX0068021

Permit No. TX0068021
Application No. TX0068021

AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Federal Water Pollution Control Act, as amended, (33 U.S.C. 1251 et. seq; the "Act"),

Texas Utilities Generating Company
2001 Bryan Tower
Dallas, Texas 75201

is authorized to discharge from a facility located at Twin Oak Steam Electric Station, Robertson County, Texas

to receiving waters named Twin Oak Reservoir, thence to Duck Creek, thence to the Navasota River

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, and III hereof.

This permit shall become effective on

This permit and the authorization to discharge shall expire at midnight,

Signed this day of

Myron O. Knudson, P.E.
Director, Water Management Division (6W)

PART I
REQUIREMENTS FOR NPDES PERMITS

SECTION A. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

1. Outfall 001

During the period beginning the effective date and lasting through the expiration date of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 001 - condenser noncontact cooling water.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	1470	1470
Temperature (°C)	N/A	N/A	43.3(110°F)[2]	46.1(115°F)[3]
Free Available Chlorine[4]	9(204)	232(511)	0.2 mg/l	0.5 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	Continuous[1]	Record
Temperature	Continuous[1]	Record
Free Available Chlorine[4]	1/week	Grab

[1] May be pumping records
[2] See Part III, paragraph C
[3] Instantaneous maximum
[4] See Part III, paragraph D

The pH shall not be less than N/A standard units nor greater than N/A standard units and shall be monitored N/A.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Prior to discharge to Twin Oak Reservoir.

2. Outfall 002

During the period beginning the effective date and lasting through the expiration date of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 002 - lignite and limestone area runoff.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Total Suspended Solids	N/A	N/A	N/A	50 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	Daily	Estimate
Total Suspended Solids	1/week[1]	Grab

* Report
[1] During periods of discharge

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Prior to discharge to Twin Oak Reservoir.

3. Outfall 003

During the period beginning the effective date and lasting through the expiration date of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 003 - sanitary sewage.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Total Suspended Solids	N/A	N/A	30 mg/l	45 mg/l
Biochemical Oxygen Demand (BOD_5)	N/A	N/A	30 mg/l	45 mg/l

Effluent Characteristic	Monitoring Requirements Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	Daily	Estimate
Total Suspended Solids	1/week	Grab
Biochemical Oxygen Demand	1/week	Grab

* Report

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Prior to discharge to Pond "A" of Twin Oak Reservoir.

4. Outfall 004

During the period beginning the effective date and lasting through the expiration date of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 004 - oil storage area runoff.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Total Suspended Solids	N/A	N/A	30 mg/l	100 mg/l
Oil & Grease	N/A	N/A	15 mg/l	20 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	Daily	Estimate
Total Suspended Solids	1/week[1]	Grab
Oil & Grease	1/week[1]	Grab

* Report
[1] During periods of discharge

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample[1].

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Prior to discharge to Pond "A" of Twin Oak Reservoir.

5. Outfall 005

During the period beginning the effective date and lasting through the expiration date of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 005 - low volume wastes.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Total Suspended Solids	N/A	N/A	30 mg/l	100 mg/l
Oil & Grease	N/A	N/A	15 mg/l	20 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	Daily	Estimate
Total Suspended Solids	1/week	Grab
Oil & Grease	1/week	Grab

* Report

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Prior to discharge to Twin Oak Reservoir.

6. Outfall 006

During the period beginning the effective date and lasting through the expiration date of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 006 - bottom ash sluice water.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Total Suspended Solids	28.7(63)[1] 57.4(126)[2]	N/A	30 mg/l	100 mg/l
Oil & Grease	14.6(32)[1] 29.2(64)[2]	N/A	15 mg/l	20 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	Daily	Estimate
Total Suspended Solids	1/week	Grab
Oil & Grease	1/week	Grab

* Report
[1] One unit in operation
[2] Two units in operation

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Prior to discharge to Pond "A" of Twin Oak Reservoir.

7. Outfall 106

During the period beginning the effective date and lasting through the expiration date of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 106 - metal cleaning wastes.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Iron, Total	N/A	N/A	1.0 mg/l	1.0 mg/l
Copper, Total	N/A	N/A	1.0 mg/l	1.0 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	Daily	Estimate
Iron, Total	1/week	Grab
Copper, Total	1/week	Grab

* Report

The pH shall not be less than N/A standard units nor greater than N/A standard units and shall be monitored N/A.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Prior to commingling with ash transport water and discharge to the bottom ash pond.

8. Outfall 007

During the period beginning the effective date and lasting through the expiration date of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 007 - fly ash and FGD system water accumulation; rainfall drainage from FGD and ESP pipe race area.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Total Suspended Solids	N/A	N/A	30 mg/l	100 mg/l
Oil & Grease	N/A	N/A	15 mg/l	20 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	Daily	Estimate
Total Suspended Solids	1/week[1]	Grab
Oil & Grease	1/week[1]	Grab

* Report
[1] During periods of discharge

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample[1].

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Prior to discharge to Pond "A" of Twin Oak Reservoir.

9. Outfall 008

During the period beginning the effective date and lasting through the expiration date of this permit, the permittee is authorized to discharge from outfall(s) serial number(s) 008 - railroad runoff.

Such discharges shall be limited and monitored by the permittee as specified below:

Effluent Characteristic	Discharge Limitations			
	kg/day(lbs/day)		Other Units (Specify)	
	Daily Avg	Daily Max	Daily Avg	Daily Max
Flow-m^3/Day(MGD)	N/A	N/A	(*)	(*)
Total Suspended Solids	N/A	N/A	30 mg/l	100 mg/l
Oil & Grease	N/A	N/A	15 mg/l	20 mg/l

Effluent Characteristic	Monitoring Requirements	
	Measurement Frequency	Sample Type
Flow-m^3/Day(MGD)	Daily	Estimate
Total Suspended Solids	1/week[1]	Grab
Oil & Grease	1/week[1]	Grab

* Report
[1] During periods of discharge

The pH shall not be less than 6.0 standard units nor greater than 9.0 standard units and shall be monitored 1/week by grab sample[1].

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Samples taken in compliance with the monitoring requirements specified above shall be taken at the following location(s): Prior to discharge to Pond "A" of Twin Oak Reservoir.

SECTION B. SCHEDULE OF COMPLIANCE

The permittee shall achieve compliance with the effluent limitations specified for discharges in accordance with the following schedule:

NONE

PART II
STANDARD·CONDITIONS FOR NPDES PERMITS

SECTION A. GENERAL CONDITIONS

1. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

2. Penalties for Violations of Permit Conditions

The Clean Water Act provides that any person who violates a permit condition implementing sections 301, 302, 306, 307, 308, 318, or 405 of the Clean Water Act is subject to a civil penalty not to exceed $10,000 per day of such violation. Any person who willfully or negligently violates permit conditions implementing sections 301, 302, 306, 307, or 308 of the Clean Water Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both.

3.. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this permit, including such accelerated or additional monitoring as necessary to determine the nature and impact of the noncomplying discharge.

4. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause including, but not limited to, the following:

a. Violation of any terms or conditions of this permit;

b. Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts; or

c. A change in any condition that requires either a temporary or permanent reduction or elimination of the authorized discharge.

The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

5. Toxic Pollutants

Notwithstanding paragraph A-4, above, if a toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is established under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and such standard or prohibition is more stringent than any limitation for such pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition and the permittee so notified.

The permittee shall comply with effluent standards or prohibitions established under section 307(a) of the Clean Water Act for toxic pollutants within the time provided in the regulations that establish those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

6. Civil and Criminal Liability

Except as provided in permit conditions on "Bypassing" Section B, Paragraph B-3 and "Upsets" Section B, Paragraph B-4, nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance.

7. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

8. State Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

9. Property Rights

The issuance of this permit does not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of Federal, State or local laws or regulations.

10. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

SECTION B. OPERATION AND MAINTENANCE OF POLLUTION CONTROLS

1. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

2. Duty to Halt or Reduce Activity

Upon reduction, loss, or failure of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control production or all discharges or both until the facility is restored or an alternative method of treatment is provided. This requirement applies, for example, when the primary source of power of the treatment facility fails or is reduced or lost. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

3. Bypass of Treatment Facilities

a. Definitions

(1) "Bypass" means the intentional diversion of waste streams from any portion of a treatment facility.

(2) "Severe property damage" means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence of a bypass. Severe property damage does not mean economic loss caused by delays in production.

b. Bypass not exceeding limitations. The permittee may allow any bypass to occur which does not cause effluent limitations to be exceeded, but only if it also is for essential maintenance to assure efficient operation. These bypasses are not subject to the provisions of paragraphs c and d of this section.

c. Notice

(1) Anticipated bypass: If the permittee knows in advance of the need for a bypass, it shall submit prior notice, if possible at least ten days before the date of the bypass.

(2) Unanticipated bypass. The permittee shall submit notice of an unanticipated bypass as required in Section D, Paragraph D-6 (24-hour notice).

d. Prohibition of bypass.

(1) Bypass is prohibited and the Director may take enforcement action against a permittee for bypass, unless:

(a) Bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(b) There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee could have installed adequate backup equipment to prevent a bypass which occurred during normal periods of equipment downtime or preventive maintenance; and

(c) The permittee submitted notices as required under paragraph c of this section.

(2) The Director may approve an anticipated bypass, after considering its adverse effects, if the Director determines that it will meet the three conditions listed above in paragraph d(1) of this section.

4. Upset Conditions

a. Definition. "Upset" means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

b. Effect of an upset. An upset constitutes an affirmative defense to an action brought for noncompliance with such technology-based permit effluent limitations if the requirements of paragraph c of this section are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

c. Conditions necessary for a demonstration of upset. A permittee who wishes to establish the affirmative defense of upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence that:

(1) An upset occurred and that the permittee can identify the specific cause(s) of the upset;

(2) The permitted facility was at the time being properly operated; and

(3) The permittee submitted notice of the upset as required in Section D, Paragraph D-6.

(4) The permittee complied with any remedial measures required under Section A, Paragraph A-3.

d. Burden of proof. In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

5. Removed Substances

Solids, sludges, filter backwash, or other pollutants removed in the course of treatment or control of wastewaters shall be disposed of in a manner such as to prevent any pollutant from such materials from entering navigable waters.

SECTION C. MONITORING AND RECORDS

1. Representative Sampling

Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge. All samples shall be taken at the monitoring points specified in this permit and, unless otherwise specified, before the effluent joins or is diluted by any other wastestream, body of water, or substance. Monitoring points shall not be changed without notification to and the approval of the Director.

2. Flow Measurements

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to insure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated and maintained to insure that the accuracy of the measurements are consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than ± 10% from true discharge rates throughout the range of expected discharge volumes. Guidance in selection, installation, calibration and operation of acceptable flow measurement devices can be obtained from the following references:

a. "A Guide to Methods and Standards for the Measurement of Water Flow", U. S. Department of Commerce, National Bureau of Standards, NBS Special Publication 421, May 1975, 97 pp. (Available from the U. S. Government Printing Office, Washington, D. C. 20402. Order by SD catalog No. C13.10:421).

b. "Water Measurement Manual", U. S. Department of Interior, Bureau of Reclamation, Second Edition, Revised Reprint, 1974, 327 pp. (Available from the U. S. Government Printing Office, Washington, D. C. 20402. Order by Catalog No. I27.19/2:W29/2, Stock No. S/N 24003-0027).

c. "Flow Measurement in Open Channels and Closed Conduits, U. S. Department of Commerce, National Bureau of Standards, NBS Special Publication 484, October 1977, 982 pp. (Available in paper copy or microfiche from National Technical Information Service (NTIS), Springfield, VA 22151. Order by NTIS No. PB-273 535/5ST).

d. "NPDES Compliance Sampling Manual", U. S. Environmental Protection Agency, Office of Water Enforcement, Publication MCD-51, 1977, 140 pp. (Available from the General Services Administration [8FFS], Centralized Mailing Lists Services, Building 41, Denver Federal Center, Denver, CO 80225).

3. Monitoring Procedures

Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

4. Penalties for Tampering

The Clean Water Act provides that any person who falsifies, tampers with, or knowingly renders inaccurate, any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

5. Reporting of Monitoring Results

Monitoring results must be reported on a Discharge Monitoring Report (DMR) form (EPA No. 3320-1). Monitoring results obtained during the previous 3 months shall be summarized for each month and reported on a DMR form postmarked no later than the 28th day of the month following the completed reporting period. The first report is due ________________. Duplicate copies of DMR's signed and certified as required by Section D, Paragraph D-11, and all other reports required by Section D, Reporting Requirements, shall be submitted to the Regional Administrator and the State at the following addresses:

Myron O. Knudson, P.E., Director
Water Management Division (6W)
U.S. Environmental Protection Agency
Region VI
First International Building
1201 Elm Street
Dallas, Texas 75270

6. Additional Monitoring by the Permittee

If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the DMR. Such increased frequency shall also be indicated.

7. Averaging of Measurements

Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless other wise specified by the Director in the permit.

8. Retention of Records

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report or application. This period may be extended by request of the Director at any time.

9. Record Contents

Records of monitoring information shall include:

a. The date, exact place, time and methods of sampling or measurements;

b. The individual(s) who performed the sampling or measurements;

c. The date(s) analyses were performed;

d. The individual(s) who performed the analyses;

e. The analytical techniques or methods used; and

f. The results of such analyses.

10. Inspection and Entry

The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit, and

d. Sample or monitor at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the Clean Water Act, any substances or parameters at any location.

SECTION D. REPORTING REQUIREMENTS

1. Planned Changes

The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility.

2. Anticipated Noncompliance

The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. Transfers

This permit is nontransferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Clean Water Act.

4. Monitoring Reports

Monitoring results shall be reported at the intervals and in the form specified in Section C, Paragraph C-5 (Monitoring).

5. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

6. Twenty-Four Hour Reporting

The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance. The Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

The following shall be included as information which must be reported within 24 hours:

a. Any unanticipated bypass which exceeds any effluent limitation in the permit.

b. Any upset which exceeds any effluent limitation in the permit.

c. Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in Part III of the permit to be reported within 24 hours.

7. Other Noncompliance

The permittee shall report all instances of noncompliance not reported under Section D, Paragraphs D-1, D-4, D-5, and D-6 at the time monitoring reports are submitted. The reports shall contain the information listed in Paragraph D-6.

8. Changes in Discharges of Toxic Substances

The permittee shall notify the Director as soon as it knows or has reason to believe:

a. That any activity has occurred or will occur which would result in the discharge of any toxic pollutant which is not limited in the permit, if that discharge will exceed the "notification levels" described in 40 CFR 122.61.

b. That they have begun or expect to begin to use or manufacture as an intermediate or final product or byproduct any toxic pollutant which was not reported in the permit application.

9. Duty to Provide Information

The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

10. Duty to Reapply

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application should be submitted at least 180 days before the expiration date of this permit. The Director may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date.

11. Signatory Requirements

All applications, reports or information submitted to the Director shall be signed and certified.

a. All permit applications shall be signed as follows:

  (1) For a corporation: by a principal executive officer of at least the level of vice-president;

  (2) For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

  (3) For a municipality, State, Federal, or other public agency: by either a principal executive officer or ranking elected official.

b. All reports required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

  (1) The authorization is made in writing by a person described above.

  (2) The authorization specified either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, or position of equivalent responsibility. (A duly authorized representative may thus be either a named individual or any individual occupying a named position.); and

  (3) Certification. Any person signing a document under this section shall make the following certification:

> "I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

12. Availability of Reports

Except for data determined to be confidential under 40 CFR Part 2, all reports prepared in accordance with the terms of this permit shall be available for public inspection at the offices of the State water pollution control agency and the Regional Administrator. As required by the Act, permit applications, permits and effluent data shall not be considered confidential.

13. Penalties for Falsification of Reports

The Clean Water Act provides that any person who knowingly makes any false statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than 6 months per violation, or by both.

PART III
OTHER CONDITIONS

A. There shall be no discharge of polychlorinated byphenyl transformer fluid.

B. The "daily average" concentration means the arithmetic average (weighted by flow value) of all the daily determinations of concentration made during a calendar month. Daily determinations of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the daily determination of concentration shall be the arithmetic average (weighted by flow value) of all the samples collected during that calendar day.

The "daily maximum" concentration means the daily determination of concentration for any calendar day.

C. Daily average temperature is defined as the flow weighted average temperature (FWAT) and shall be computed and recorded on a daily basis. FWAT shall be computed at equal time intervals not greater than two hours. The method of calculating FWAT is as follows:

$$\text{FWAT} = \frac{\text{SUMMATION (INSTANTANEOUS FLOW X INSTANTANEOUS TEMPERATURE)}}{\text{SUMMATION (INSTANTANEOUS FLOW)}}$$

D. The term "free available chlorine" shall mean the value obtained using the amperometric titration method for free available chlorine described in the latest edition of "Standard Methods for the Examination of Water and Wastewater".

E. Neither free available chlorine nor total residual chlorine may be discharged from any unit for more than two hours in any one day and not more than one unit in any plant may discharge free available or total residual chlorine at any one time unless the permittee can demonstrate to the permitting Agency that the units in a particular location cannot operate at or below the limitations specified in this permit.

F. Based on information submitted by TUGCO, the intake structure design is approved for best technology available pursuant to section 316(b) of the Clean Water Act.

INDEX

INDEX

- Alternatives
  - General Description 1-4, 1-5
  - No Action .... 5-(1-2)
  - Alternatives Not Requiring Project 5-3, 5-4, 5-5
  - Energy Sources 5-3, 5-6, 5-7
  - Power Plant Sites 5-3, 5-8, 5-10
  - Alternative Cooling Systems 5-10

- Aluminum Company of America (ALCOA) 4-1

- Air Pollution Control System 1-4, 5-22

- Air Quality (See also Climatology)
  - Existing Conditions .... 6-64, 6-(57-64)
  - No Action Alternative 6-64
  - Alternative Impacts 5-12
  - Construction and Operations Impacts .... 1-7, 6-(64-74)

- Applicant (Description of) 3-1

- Aquatic Communities
  - Existing Conditions .... 6-(82-85)
  - No Action Alternative 6-95
  - Construction and Operations Impacts .... 1-8, 6-(95-96), 6-98, 6-(99-103)

- Clean Air Act 1-1

- Climatology .... 6-(52-57)

- Community Services and Facilities
  - Existing Conditions .... 6-(122-124)
  - No-Action Alternative 6-124
  - Construction and Operations Impacts 6-138

- Condenser Cooling Water System 1-4

- Cooling Reservoir 5-19, 5-24

- Cultural Resources 6-108
  - Existing Conditions .... 6-(108-112)
  - No Action Alternative 6-112
  - Construction and Operations Impacts .... 1-8, 6-(112-114)

- Demography and Population
  - Existing Conditions .... 6-(114-120)
  - No Action Alternative .... 6-124, 6-(133-136)
  - Construction and Operations Impacts 6-128, 6-133

- Economic Activity and Trends
  - Existing Conditions .... 6-117, 6-(119-120)
  - No Action Alternative 6-124
  - Construction and Operations Impacts .... 6-133, 6-(135-136)

INDEX (cont'd)

Employment - See Economic Activity and Trends

Energy Reliability Council for Texas 4-2

Energy Resources
  Existing Conditions .... 6-(164-165)
  No Action Alternative 6-165
  Construction and Operations Impacts .... 1-12, 6-(165-166)

Environmental Control
  Preferred Alternative 5-51, 5-57

Federal Water Pollution Control Act 1-1

Geology
  Existing Condition (project area) .... 6-(2-3)
  No Action Alternative 6-10
  Construction and Operations Impacts (Plant) 1-5, 6-10
  Construction and Operation Impacts (Mine) 6-15
  Construction and Operation Transport 6-14

Ground Water Hydrology
  Existing Conditions .... 6-(17-28)
  No Action Alternative 6-29
  Construction and Operations Impacts (Power Plant) 1-6, 6-29
  Construction and Operations Impacts (Mine) .... 1-6, 6-(29-31)
  Construction and Operations Impacts (Transport) 6-29

Housing
  Existing Conditions 6-120, 6-122, 6-123
  No Action Alternative 6-124
  Construction and Operations Impacts .... 6-(137-139)

Income - See Economic Activity and Trends

Land Use
  Existing Conditions .... 6-(140-143)
  No Action Alternative 6-143
  Construction and Operations Impacts .... 1-8, 6-(145-146)

Liquid Waste Management System 1-2, 1-4

Local Government Finances - See Economic Activity and Trends

Minerals
  Existing Conditions (project area) 6-4
  No Action Alternative 6-10
  Construction and Operations Impacts (Power Plant) 1-5, 6-10
  Construction and Operation Impacts (Transport) 6-14
  Construction and Operation Impacts (Mine) 6-15

INDEX (cont'd)

Mitigation of Impacts - See Environmental Control

NPDES Permit ....3-1, 3-5, 4-2, Appendix C

National Environmental Policy Act of 1969 1-1

Permits (Required) 5-57

Proposed Project (also preferred alternative)
    General Description ....1-1, 3-(1-6), 4-(1-6), 5-14
    Facilities Layout and Operation of Mining Areas ....5-14, 5-(48-51)
    Plant Systems and Operating Procedure 5-19, 5-38
    Cooling Reservoir ....5-24, 5-27, 5-28, 5-(34-38)

Public Health
    Existing Conditions ....6-(160-161)
    No Action Alternative 6-161
    Construction and Operations Impacts ....6-(162-164)

Railroad Facilities 5-39, 5-46

Reclamation 1-4

Recreation Facilities and Aesthetics 1-9
    Existing Conditions 6-147
    No Action Alternative 6-147
    Construction and Operations Impacts ....6-(147-149)

Socioeconomic Resources - See Demography and Population, Community
    Facilities, Economic Activity and Trends, and Housing

Soils
    Existing Conditions (project area) ....6-4, 6-(8-10)
    No Action Alternative 6-10
    Construction and Operations Impacts (Transport) 6-14
    Construction and Operations Impacts (Power Plant) 1-5, 6-14
    Construction and Operations Impacts (Mine) ....6-(16-17)

Solid Waste Disposal Systems 1-3, 1-4
    Proposed Action (preferred) ....5-(32-33)

Sound Quality
    Existing Conditions ....6-(73-77)
    No Action Alternative 6-76
    Construction and Operations Impacts ....1-7, 6-(78-81)

Surface Water Hydrology
    Existing Conditions 6-17, 6-42, 6-46
    Hydrology ....6-(31-37)
    Water Quality ....6-32, 6-(38-42)
    No Action Alternative 6-46
    Construction and Operations Impacts ....1-6, 6-(47-52)

INDEX (concluded)

Terrestrial Communities
    Existing Conditions ....6-(86-95)
    No Action Alternative 6-96
    Construction and Operations Impacts ....1-7, 6-(96-98), 6-99, 6-104

Texas Power and Light Company 1-4

Threatened or Endangered Species
    Existing Conditions ....6-(93-95)
    No Action Alternative 6-95
    Construction and Operations Impacts 1-7, 6-98, 6-107

Topography
    Existing Conditions (project area) ....6-(1-2)
    No Action Alternative 6-10
    Construction and Operations Impacts (Plant) 1-5, 6-10
    Construction and Operations Impacts (Transport) 6-14
    Construction and Operations Impacts (Mine) 6-15

Transmission Facilities ....5-(43-49)
    Alternatives 1-4
    Preferred ....5-(39-46)

Transportation Facilities
    Proposed Action 1-9, 5-50, 5-52
    Existing Conditions ....6-(149-152)
    No Action Alternative 6-153
    Construction and Operations Imapcts ....6-14, 6-(153-160)

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